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COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES A.

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MARKKULA (M.) & TINNILÄ (A.). **Studies of the Biology of the Lesser Clover Leaf Weevil, *Phytonomus nigrirostris* Fabr. (Col. Curculionidae).** —*Valt. Maatalousk. Julk.* no. 152 (1956) 62 pp., 23 figs., 46 refs. Helsinki, 1957. (With a Summary in Finnish.)

The authors briefly describe all stages of *Hypera* (*Phytonomus*) *nigrirostris* (F.), the most important pest of red clover (*Trifolium pratense*) in Finland, review its world distribution, and give an account of investigations on its bionomics in the insectary and field near Helsinki in 1953–55. The observations on oviposition in 1954 have already been noticed [*R.A.E.*, A **44** 249], and those in 1955 confirmed the earlier results.

The first larvae hatched at the beginning of June in 1953–54, when the weather was unusually warm, but some four weeks later in 1955, when it was cool. They were not very active and preferred sheltered positions. They attacked almost exclusively the younger growth of the clover, and were often found between the stipules, feeding on the young shoots, or, in the case of the older larvae, on the main stem [*cf.* **36** 115]. Some of them moved to the buds and, if they were present sufficiently late in the season, they frequently occurred between the bracts and fed on the florets or penetrated into the head between the florets. In 1955, as many as 60 per cent. of the larvae were found in the inflorescences. Usually one and never more than two larvae were observed in one stipule or inflorescence at a time. The cocoons were generally formed within the stipules or inflorescences. The larvae were present for six weeks in 1953–54, pupae were found from late June to mid-July, and the first adults of the new generation appeared in the second week of July. In 1955, the larvae were present for only four weeks, the pupae occurred from about 20th July to 5th August, and the first adults appeared on 29th July. They fed mainly on the leaves and to a lesser extent on the stipules and stems, and entered hibernation in the clover fields after mid-August. There was only one generation a year. Under natural conditions in the insectary, the duration of the egg stage ranged from 8 days at about 21°C. [69·8°F.] to 30 days at 11·5°C. [52·7°F.], that of the larval stage from 14 days at 20·4°C. [68·7°F.] to 20 days at 17·1°C. [62·8°F.] and that of the pupal stage from 10 days at 18·6°C. [65·5°F.] to 16 days at 16·6°C. [61·9°F.].

Although red clover was preferred by both larvae and adults, eggs were observed on alsike and zigzag clovers (*T. hybridum* and *T. medium*) in the field, and development was completed on these and on white clover (*T. repens*) in the insectary.

Brandt (H.). **Welcher Schädling ist das? Schädlinge und Krankheiten an landwirtschaftlichen Kulturpflanzen.** [What Pest is that? Pests and Diseases of agricultural Crops.]—Kosmos-Naturführer, 158 pp., 8 col. pls., text illus. Stuttgart, Franckh'sche Verlagshandl., 1957. Price *DM*. 11.80 cloth; *DM*. 9.80 paper cover.

The field crops dealt with in this handbook for agriculturists in Germany include, notably, cereals, pasture grasses, leguminous fodder crops, root crops, oil-seed plants, tobacco, hops, flax and hemp, and the information given on their pests and diseases resembles in scope and arrangement that in a companion volume already noticed [*R.A.E.*, A **45** 453].

Drees (H.) & Schwitulla (H.). **Über Parasitierungs-Versuche bei** *Lymantria dispar* **L. mit** *Apanteles solitarius* **Ratz. W.** [Tests on the Use of *A. solitarius* against *L. dispar*.]—*Anz. Schädlingsk.* **29** pt. 6 pp. 81–85, 6 figs., 18 refs. Berlin, 1956.

Investigations on the effectiveness of *Apanteles solitarius* (Ratz.) as a parasite of *Lymantria dispar* (L.) were made in a fairly well isolated plot containing 53 assorted fruit trees and other vegetation near Cologne. The bionomics of the two insects are described, and it is stated that the fertilised females of *A. solitarius* overwinter in low vegetation, in sheltered sites at the base of the trees and in cracks in the bark and resume activity 8–14 days before the overwintered eggs of *L. dispar* begin to hatch. They lay only one egg per larva and fly but little, so that parasitism tends to be concentrated in limited foci. The full-fed parasite larva leaves the host and pupates close by it, the pupal stage lasting 10–14 days.

The plot had been neglected, infestation by *L. dispar* was heavy, and *A. solitarius* was present in 1950, when the observations began, only on one plum tree, on which 31 of 68 larvae were parasitised by it. In the spring of 1951, seven egg-masses of *L. dispar* were found on this tree, from which 2,100 larvae were expected to develop. Further egg-masses were taken from other trees and added to the seven, to ensure that the parasite should multiply at its maximum rate, and it was later found that 2,961 of the 4,837 larvae that hatched were parasitised by it. Of the resulting *Apanteles* cocoons, 2,000 were distributed in equal numbers over 20 further trees, and further observations were made in 1952. In that year, 5,747 cocoons of *A. solitarius* were found, almost all of them on the lower half of the trees and none on the uppermost parts; over 80 per cent. of them were on the south-east side of the trees, where most of the young *Lymantria* larvae occur. In 1953, over eight times as many cocoons were found at the base of the south-east side of the trees as in 1952, and a similar rate of increase was observed on trees on which the parasite had not previously occurred but on which cocoons had been placed in 1952. *A. solitarius* was found to have spread almost throughout the plot in 1953 and to have brought *L. dispar* under satisfactory control, whereas collection of the larvae and chemical methods were still required in neighbouring areas.

Kovačević (Ž.). **Die Nahrungswahl und das Auftreten der Pflanzenschädlinge.** [Food-plant Selection and the Occurrence of Plant Pests.] —*Anz. Schädlingsk.* **29** pt. 7 pp. 97–101, 8 refs. Berlin, 1956.

An account is given of experiments carried out at Zagreb in 1950–55 to study the effects of different food-plants on the population dynamics of four polyphagous Lepidoptera that are pests of deciduous trees in Yugoslavia. Most of them concerned *Lymantria dispar* (L.), outbreaks of which occur frequently in forests in certain parts of the country. Field-collected egg-masses of this species on oak (*Quercus robur* (*pedunculata*)) were transferred to the laboratory in early 1950, and the larvae were reared on leafy twigs of oak (*Q. robur* or *Q. sessiliflora*), hornbeam, beech, apple or plum. The cultures on *Q. robur* maintained themselves throughout the six years, though mortality was fairly high and reached 98 and 99 per cent. in 1951 and 1955, respectively, those on *Q. sessiliflora* died out in 1955, and those on the other trees died out almost every year, so that eggs had to be introduced from the cultures on oak. The food-plant affected the duration of development, that of males ranging from 79 days on beech to 70 days on *Q. robur* and that of females from 81 days on apple to 68 days on hornbeam, with some variation according to the origin of the cultures. Females usually had five moults, but some had four or six, and males reared on *Q. sessiliflora* or beech also had five, all others having only four. Outbreaks on *Q. robur* in forests usually last 4–5 years and those on beech 2–3, and that their duration is affected by the food-plant was confirmed in a test in which larvae from the coastal area, where *Q. ilex* is the main food-plant, showed 26 per cent. mortality on this tree, 60 per cent. on bitter cherry, 83 and 86 per cent. on *Ostrya carpinifolia* and *Q. cerris*, and 98 per cent. or more on *Q. sessiliflora*, *Q. robur*, hornbeam, beech, apple and plum. Some of the mortality in the main tests was caused by polyhedral disease, which is considered to be present in all populations of *L. dispar*. There was an outbreak of it in 1951, but whereas it did not cause complete mortality of the larvae on oak, it did so on all the other plants. Mortality due to this disease usually becomes high during the later stages of an outbreak of *L. dispar*, and the influence of the less favourable food-plants on it is held to be exercised through their contribution to the general physiological weakening of the insect population. Other diseases are favoured in like manner. Outbreaks of *L. dispar* can thus persist only on the most favoured food-plants, which appear to be *Q. robur* in the lowlands of Croatia, *Q. ilex* in the coastal area and *Q. coccifera* in Macedonia. There may be still other local races or ecotypes.

The tests with the other insects were less detailed. *Malacosoma neustria* (L.) is mainly a pest of fruit trees but also infests oaks. Cultures originating from fruit trees throve on leaves of the same species in the laboratory, and transfer of eggs or young larvae from *Q. ilex* to a mixture of leaves of *Q. ilex* or fruit trees had no ill effects. *Euproctis similis* (Fuessly) (*chrysorrhoea*, auct.) is a pest of oaks, fruit trees and *Arbutus unedo*. The rearing tests showed little difference in the suitability of leaves from these trees, but mortality was rather high and fewer eggs were laid when individuals from *A. unedo* or plum were transferred to pear. The introduced *Hyphantria cunea* (Dru.) is highly polyphagous. In 1953, three generations were reared on mulberry, plum, cherry, apple, walnut and hornbeam, two on lilac and one on oak, and the reproductive potential was highest on the first two and (in the first generation) on hornbeam. Not more than two generations developed in 1954, and reproduction was again greatest on mulberry and plum. Climate is therefore held to be of equal importance with food-plants in the occurrence of outbreaks of this insect.

TANASIJEVIĆ (N.). **Morfologija i razviće surlaša** *Tychius flavus* **Beck.** [Morphology and Development of *T. flavus*.]—*Plant Prot.* no. 29 pp. 3–33, 5 pls., 12 figs., 4 graphs, 14 refs. Belgrade, 1955. (With a Summary in English.)

Tychius flavus Becker is an important pest of the seed pods of lucerne in Yugoslavia. The author describes all stages of this weevil and the genitalia of both sexes, and gives an account of investigations on its bionomics [*cf.* *R.A.E.*, A **39** 72], carried out near Zemun in 1952–54. The adults overwintered in the cocoons and appeared in the fields at the end of March or the beginning of April, when the average daily temperatures of the air were 11°C. [51·8°F.] or above and the average soil temperatures were above 12·4°C. [54·32°F.]. They survived above ground for 10–12 months and did little direct damage, though their feeding on the flowers caused withering if attack was heavy. Maturation feeding continued for up to 90 days, and pairing was first observed in early June. Oviposition began after mid-June, the eggs being inserted into the pods through the edges. Eggs were laid singly, at the rate of up to 42 per female. The larvae hatched in 5–11 days at 24–28°C. [75·2–82·4°F.], provided that the relative humidity exceeded 60 per cent., and fed in the seeds for 15–20 days, at an average temperature of 24°C., after which they entered the soil and pupated after 6–12 days at depths of not more than about 3 ins., pupae being first observed in early August. The pupal stage lasted 14–17 and 7 days at constant temperatures of 22 and 30°C. [71·6 and 86°F.], respectively.

GRADOJEVIĆ (Z.). *Meigenia bisignata* **Mg. (Dipt., Tachinidae) parazit lucerkine bube.** [*M. bisignata*, a Parasite of *Phytodecta fornicata.*]—*Plant Prot.* no. 29 pp. 57–61, 3 figs., 1 ref. Belgrade, 1955. (With a Summary in French.)

Meigenia bisignata (Mg.) was observed in 1952 parasitising the larvae of *Phytodecta fornicata* (Brüggem.) on lucerne near Belgrade. The females of this Tachinid appeared in early May and laid their eggs on the second- and third-instar larvae. Parasitised larvae continued their development and entered the soil, but did not pupate. The Tachinid pupated within the skin of the host larva 2–3 days later. The percentage parasitism among larvae collected in one lucerne field was 13.

LAZAREVIĆ (B.). **Biologija i suzbijanje višnjevog svrdlaša.** [The Bionomics and Control of *Rhynchites auratus*.]—*Plant Prot.* no. 30 pp. 11–36, 6 pls., 1 graph, 9 refs. Belgrade, 1955. (With a Summary in English.)

The author describes all stages of *Rhynchites auratus* (Scop.), which is an important but little known pest of cherry and sour cherry in Serbia, damaging up to 98 per cent. of the fruits of sour cherry, and gives an account of observations on its bionomics in 1950–54. The weevil hibernates in the soil as a full-fed larva or sexually immature adult. The overwintering larvae remain in diapause until the end of the following summer, when they pupate and give rise to adults that overwinter. The overwintered adults appear in the orchards in early April at soil temperatures of 8–10°C. [46·4–50°F.], and feed on the flower and leaf buds and later on the young fruits. They pair after about a month, and the females lay their eggs in the fruits, the total number of eggs per female ranging from 56 to 121. The larvae hatch in 15 days at an average temperature of 17°C. [62·6°F.] and enter the stones of the fruits and feed on the kernels. They leave when full-fed and enter the soil, where a few of them pupate at the end of summer (August–September), giving rise to adults that overwinter, and the majority enter diapause. Control is best effected by spraying with about 0·15 per cent. DDT when the fruits begin to form, with a preliminary application before flowering if infestation is heavy.

Mijušković (M.) & Mirčetić (S.). **Ogledi suzbijanja maslinove mušice parationskim sredstvima na Crnogorskom Primorju.** [Experiments on the Control of *Dacus oleae* by Means of Parathion on the Coast of Montenegro.]—*Plant Prot.* no. 31 pp. 45–59, 1 pl., 4 graphs, 6 refs. Belgrade, 1955. (With a Summary in French.)

Dacus oleae (Gmel.) causes 40–50 per cent. loss of olives on the Montenegran coast of Yugoslavia, and experiments on its control by means of E-605 forte, which contains 46·7 per cent. parathion, were carried out in 1954. Sprays of 0·06, 0·08 and 0·1 per cent. E-605 forte were applied in early September or early October or at both periods, and the results showed that the lower concentrations were ineffective, even when two applications were made, and the highest effective only when applied in September or on both dates, when it gave 79·8 and 86·2 per cent. kill of larvae in the olives, respectively. Mortality rose sharply 4–5 days after the first application, so that absorption of parathion by the fruits requires about this period, and it continued throughout the period of the test.

Radović (M.) & Despotović (P.). **Rezultati suzbijanja ambarskih štetočina preparatom Phostox.** [The Results of controlling Granary Pests with the Preparation Phostox.]—*Plant Prot.* no. 31 pp. 85–92, 3 refs. Belgrade, 1955. (With a Summary in English.)

Phostox tablets, which give off phosphine at the rate of 1 gm. per tablet on contact with moisture [*cf.* *R.A.E.*, A **45** 294], were tested for the control of pests of stored grain in Yugoslavia in 1954–55. The dosage recommended by the German manufacturers against *Calandra granaria* (L.) is 20–25 tablets per ton, but complete mortality of adults of this weevil and of *Sitotroga cerealella* (Ol.) was given by a dosage of 17 tablets per ton applied in two halves with an interval of four days. This was the maximum rate tested, but it did not completely control the immature stages.

Mijušković (M.). **Ogledi suzbijanja smokvinog mediča u NR Crnoj Gori.** [Experiments on the Control of *Ceroplastes rusci* in Montenegro.]—*Plant Prot.* no. 32 pp. 43–47, 1 fig., 6 refs. Belgrade, 1955. (With a Summary in French.)

Ceroplastes rusci (L.) is injurious to fig trees in Montenegro in certain years. Damage was severe in 1952–54, and tests on control showed that good results were given by sprays of 0·03 per cent. E-605 forte [which contains 46·7 per cent. parathion] or 1·5 per cent. white oil emulsion, applied in July, as soon as the crawlers had established themselves on the leaves. Winter sprays of various DNC products were also effective [*cf.* *R.A.E.*, A **43** 393], but had to be applied at concentrations higher than those used against other pests.

Baggiolini (M.). **Contribution à l'étude d'une lutte rationelle contre la tordeuse** *Cacoecia rosana* **L.**—*Rev. rom. Agric.* **12** no. 3 pp. 21–24, 4 figs., 6 refs. Lausanne, 1956.

Tortrix (*Cacoecia*) *rosana* (L.) has recently caused increased injury to fruit trees, especially apple, in the Canton of Vaud, Switzerland, and investigations were carried out there in 1954–55 on its habits, especially those of the larvae, and on its control. Hatching began in early April and was almost complete by the end of the month, when the apple blossom was at the pink-bud stage, the date depending on the position of the egg-masses on the tree. The larval stage lasted for up to 55 days, and buds, leaves and young fruits were attacked [*cf. R.A.E.*, A **41** 48]. Pupation occurred at the feeding site, and the pupal stage lasted 15–21 days. Adults were present from the end of May to early July, and the eggs were laid chiefly in June and July and overwintered. Observations on natural enemies showed that *Trichogramma evanescens cacoeciae* Marchal [*cf.* **37** 116] was a common parasite of the eggs of *Tortrix rosana*, 6·3 per cent. of which were attacked by the winter generation and 24·8 per cent. by the summer one, the two generations often developing in the same egg-masses [*cf.* **15** 654]. Predators, including Syrphid larvae, killed 8 per cent. of the larvae, and Hymenopterous parasites, of which the most important were *Itoplectis maculator* (F.), *Lissonota* sp., *Pseudomicromelus deplanatus* (Nees), and *Monodontomerus aereus* Wlk., caused 44 per cent. mortality of the pupae.

In dormant applications against the eggs on apple, the only spray to give effective control was 4 per cent. oil emulsion, which gave 87 per cent. kill when applied in winter and 86 per cent. when applied just before bud burst. Against the larvae, the best results were given by emulsion sprays of parathion, which gave 27, 89 and 88 per cent. control when applied at 0·5 per cent. in early April, at the pink-bud stage, and after petal fall, respectively, and 40, 95 and 61 per cent. control when similarly applied at 0·1 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] applied at 0·1 per cent. at the pink-bud stage gave 94 per cent. control. Treatment in early April was unsatisfactory because hatching had only just begun, and it was injurious to the winter generation of *Trichogramma*, and the inferior results obtained after petal fall were due to the protected feeding sites of the larvae. Sprays are therefore best applied at the pink-bud stage, just before all the larvae have hatched.

BLACHE (M.) & BOURNIER (A.). **Dégâts de thrips sur pêchers.**—*Phytoma* **9** no. 85 pp. 7–11, 3 figs. Paris, 1957.

Taeniothrips inconsequens (Uzel) and *T. vulgatissimus* (Hal.) (*meridionalis* (Priesn.)) have recently caused deformation of peaches in the department of Pyrénées-Orientales, France, and investigations were carried out there in 1955–56. The bionomics of *T. inconsequens* are described [*cf. R.A.E.*, A **23** 22, etc.], and those of *T. vulgatissimus* are thought to be similar. On peach, the eggs are laid on the organs of the flowers, and the nymphs are numerous by petal fall. They attack the pistils, causing black scars that enlarge with the fruits and result in deformation. After the fruits have set, the nymphs attack the young shoots and leaves, causing the latter to drop when infestation is severe. The adults do not fly readily, and infestation therefore spreads only slowly. Infestation was high in 1954–55, but lower in 1956, owing to the preceding wet autumn and cold winter, which killed the nymphs after they had entered the soil to pupate and the newly emerged adults, respectively. Since legislation prohibits the use of insecticides on fruit trees at flowering time, when the nymphs do most damage, a spray containing 0·2 lb. parathion per 100 gals. was applied at petal fall in 1955. Counts showed that it protected 95 per cent. of the fruits from damage. Various organic insecticides were applied in sprays at the same period in 1956, but the results were inconclusive because of heavy rain. DDT and BHC appeared to be as effective as parathion, but malathion and toxaphene seemed less satisfactory.

Milaire (H.). **Note sur le développement et le caractère des attaques de la mouche méditerranéenne des fruits** (*Ceratitis capitata* **Wied.**) **dans la moyenne vallée du Rhône.**—*C.R. Acad. Agric. Fr.* **42** no. 10 pp. 504–508. Paris, 1956.

Following severe damage in 1949 to peaches and pears in the Lyons region of the Rhône valley by *Ceratitis capitata* (Wied.), investigations were carried out each year on the incidence of this fruit-fly by means of counts of infested fruits and bait-trap catches in orchards. It was found that attack was heavy in 1950 and 1955, fairly heavy in 1952 and light in 1951 and 1953–54. Peaches, apricots and pears were most infested, and attack usually occurred late in the season. Of 23 localities in which infestation was found in 1955, 12 were near Lyons, and the remainder near other towns or villages. The bait-trap catches generally reflected the incidence of attack, but the adults responsible for the earliest infestations of the year were never taken, larvae often being present in the fruits when the adults were first captured. It is estimated that the earliest adults in 1952 appeared in early June as adults of the first generation were observed in mid-July and those of the second and third in mid-August and late September, respectively, and similar results were obtained early in the season in 1955. There is considerable overlapping of generations in the field. The fruit-fly has not been proved to overwinter in this area [*cf. R.A.E.*, A **45** 455], and the first adults to appear are thought to emerge from imported fruits. In 1953, six adults emerged between 22nd and 26th June from two grapefruits found infested in the market in Lyons on 29th May, and a further generation was reared on peaches and apricots grown locally, the adults emerging on 3rd August. The fact that the principal centres of infestation were near populated areas [*cf.* **42** 184] suggests that the fruit-fly is not endemic.

Coulon (J.). **Essais comparatifs de laboratoire sur l'action de divers insecticides sur la mouche de l'asperge** (*Platyparea poeciloptera*).—*Phytiat.-Phytopharm.* **4** no. 4 pp. 165–169. Paris, 1955.

In laboratory experiments on the relative toxicity of various organic insecticides to the asparagus fly, *Platyparea poeciloptera* (Schr.), adults were placed in batches of ten in flasks bearing known internal deposits from ether solutions of the insecticides. They were transferred to clean flasks after ten minutes and observed for mortality after a further hour. It was calculated from the results that the deposits in μg. per sq. cm. giving 50 per cent. kill were 0·2 for γ BHC, 0·26 for diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 11·47 for parathion, and 24·78 for DDT. When mortality was determined at times ranging from 0·5 to 7 hours after exposure, the shortest periods (in hours) in which complete kill was obtained, and (in brackets) the respective concentration in μg. per sq. cm., were 0·5 (5·1) and 2 (0·17) for diazinon, 1 (0·51) and 3 (0·17) for γ BHC, and 2 (10·1), 3 (5·1) and 6 (0·51) for parathion, and 2 (45·9) for DDT. Dieldrin at 5·1 μg. per sq. cm. proved totally ineffective.

Hurpin (B.). **Action de l'aldrine et du lindane sur les larves de** *Melolontha melolontha* **L.**—*Phytiat.-Phytopharm.* **4** no. 4 pp. 197–201, 2 graphs, 7 refs. Paris, 1955.

As an aldrin dust applied round strawberry plants and worked in to the soil in early April at rates of 0·9 and 1·8 lb. toxicant per acre failed to control third-instar larvae of *Melolontha melolontha* (L.) attacking the plants, laboratory experiments were carried out at Rouen in the winter of

1954–55 in which dusts and emulsified solutions of aldrin and γ BHC were tested against second- and third-instar larvae. They were mixed at four rates with garden soil, and pots filled with the treated soil were infested with two larvae each (for which food was supplied), watered regularly, and covered to reduce evaporation. Mortality was calculated according to Abbott's formula [*R.A.E.*, A **13** 331] 15–90 days later. The mortality percentages for the second- and (in brackets) the third-instar larvae were 99 (40) after 90 days for aldrin at 4·32 lb. per acre (the highest rate tried) in emulsified solution, 100 (13) after 90 days for aldrin at 4·5 lb. per acre (the highest rate tested) in a dust, 100 (50, 38 and 13) after 90, 30 and 15 days for γ BHC in emulsified solution at 1·08, 2·16 and 4·32 lb. per acre, respectively, and 100 (28 and 37) after 15 days for γ BHC at 1·8 and 3·6 lb. per acre in a dust. Complete mortality of third-instar larvae was given in 90 days by γ BHC at 4·32 lb. per acre in an emulsified solution and in 90 and 45 days by γ BHC at 2·7 and 5·4 lb. per acre, respectively, in a dust. Treatment with γ BHC at 0·9–1·35 lb. per acre is recommended for control where infestation is light, but the rate should be doubled if it is severe. Aldrin should be used in preventive treatments at 2·25–2·7 lb. per acre.

Fedotov (D. M.). Ed. **The Noxious Little Tortoise,** *Eurygaster integriceps* **Put. Work of the Laboratory of Invertebrate Morphology in Connection with the Expedition to the Province of Krasnodar in 1949–1953. Vol. 3.** [*In Russian.*]—278 pp., 76 figs., many refs. Moscow, Akad. Nauk SSSR, 1955. Price 16 *rub.* 80 *kop.*

This third volume of a work on *Eurygaster integriceps* Put. in the Soviet Union [*cf. R.A.E.*, A **40** 307] is based on the results of observations in the Province of Krasnodar in 1949–53, during an outbreak of this Pentatomid on cereals, and consists of a general introduction by the editor and five scientific papers, abstracts of which appear below.

Fedotov (D. M.) & Bocharova (O. M.). **The Dependence of the morpho-functional Condition of** *E. integriceps* **on its Conditions of Life** (pp. 7–67, 25 figs.). Investigations in 1949–53, which are described, confirmed the earlier finding [*cf.* **40** 308] that populations of *E. integriceps* differ not only in their density, but also in the morpho-functional condition of the individuals comprising them. Notes are given on the various active and passive phases in the life-cycle of the bug [*cf.* **40** 309] and on the appearance of its internal organs, which are indicative of its degree of vitality, followed by the results of regular dissections of individuals in all phases of the life-cycle during the five years. A high degree of vitality resulted from favourable environmental conditions in 1948–49, leading to a severe outbreak of the bug, but there was a subsequent gradual decline as a result of drought during the early autumn of 1950, fluctuations in temperature in the ensuing winter, and cold wet weather in spring and early summer in 1951 and 1952, when the bugs were migrating from their hibernation quarters to the grain fields, though the process was somewhat slowed down by favourable conditions for the feeding of the young adults in both these years. The outbreak apparently reached its peak in 1951, and little damage was caused in 1953. The decline was only temporary, however. It is concluded that increases and decreases in the population density of the pest are conditioned by gradual physiological changes in consecutive generations brought about by variations in environmental conditions.

Strogaya (G. M.). **Significance of some biochemical Components in the individual Development of** *E. integriceps* (pp. 68–133, 8 graphs.). The contents of water, fat and reducing substances and the changes in total weight and weight of dry matter in nymphs and adults of *E. integriceps* were investigated in 1950–52 from examples collected at intervals from various natural habitats in Krasnodar, first-instar nymphs being disregarded on account of their small size, and the material was also subjected to morpho-functional analysis. The results, which are discussed in detail, showed that the life-cycle of *E. integriceps* can be divided into four phases characterised by differences in metabolism. The first is the nymphal stage, in which intensive feeding in grain fields is accompanied by no increase in the relative content of fat or other dry matter, the food ingested being used for purposes of growth. The second phase lasts from adult emergence until migration to the hibernation quarters, during which period feeding leads to the accumulation of reserve substances in large quantity. The third phase is that of hibernation and the return to the grain fields, during which the accumulated reserves are largely exhausted, and the fourth lasts from the return to the fields until death and is characterised by intensive feeding and several cycles of reproduction. At the beginning of this phase, only the females still contain any considerable reserves [*cf.* **45** 305], and these are used for the development of the first eggs. It is concluded that observations on the accumulation and utilisation of fat reserves are useful as a supplement to morpho-functional analysis in forecasting outbreaks of the bug.

USHATINSKAYA (R. S.). **Physiological Peculiarities of** *E. integriceps* **in the Period of Quiescence with Hibernation in the Mountains and in the Plain** (pp. 134–170, 11 graphs.). In Krasnodar, *E. integriceps* spends some 9–10 months of the year in its hibernation quarters in forests in the mountains or in the plains, the adults leaving the grain fields in June–July and returning to them in April–May, and investigations were made in 1951–52 on the metabolism of the bugs during this period in relation to temperature. Some of the results have already been noticed [*cf.* **43** 123]. Climatically, the quiescent period can be divided into three parts. During the first 4–4½ months, the temperature is above freezing point, during the next 4–4½ months it is below it, and for 2–3 weeks in spring, it is again above it and activity is resumed. Such a long period of survival without feeding is facilitated by a diapause, during which metabolism is reduced and its direction changed. This condition sets in before migration from the fields, and it lasts until the end of January or the beginning of February. The metabolism of the bugs during quiescence can be divided into three phases coinciding with the three climatic periods. In the first, metabolic activity is still fairly high (though it is much reduced by the diapause), and fats and food substances participate in it. At the end of this phase, when the temperature falls below 10°C. [50°F.], the glycogen content increases, providing the fundamental source of energy for the second phase. During this, the bugs become torpid and their metabolism falls to a very low level. Carbohydrates are utilised, but not fats, except during warm spells when the temperature exceeds 0–2°C. [32–35°F.]. During the third phase, when the internal sex organs resume activity, metabolism increases, fats being utilised and carbohydrates produced.

Specific physiological adaptations permitting *E. integriceps* to survive the quiescent period were shown to be the synthesis of glycogen from fat before the onset of winter, an increase in the content of reducing substances during the cold period, and an increase in the iodine number of the fat, and hence in the content of unsaturated fatty acids, after the diapause. The hind-gut, in which uric acid and its salts are accumulated, serves as a hygroregulative apparatus during the cold period, when the water content of the body is high; the reserves of food, consisting chiefly of carbohydrates and proteins, stored in the mid-gut provide an additional source of energy. Males and females that had overwintered on the northern slopes of the mountains resumed activity with 56·5 and 64·3 per cent. of the quantity of fat, 60·4 and 76·5 per cent. of the food reserves and 87·4 and 84·2 per cent. of the carbohydrates that they had contained before hibernation. Individuals overwintering on southern slopes used more of their fat and food reserves, and those hibernating in the plains weighed less, had smaller accumulations of fat and food reserves and contained more reducing substances than those doing so in the mountains.

Arnol'di (K. V.). **The Hibernation of** *E. integriceps* **in the Mountains of the Kuban, from Investigations in 1949–53** (pp. 171–237, 19 figs.). Populations of *E. integriceps* can be divided into two main biological types according to their mode of hibernation. The first is characteristic of central Asia, where the bugs migrate from the grain fields for long distances to aestivate and later hibernate in the mountains [*cf.* **40** 309–310], and also occurs in the Crimea and the Caucasus region. The other is non-migratory, the flights to winter quarters being quite short, and populations of this type are subdivided into sedentary mountain and sedentary lowland populations. The former develop on wild grasses in the mountains, and the latter in grain fields in forest districts in the steppes. The populations that occur in the Kuban district, to the north-west of the Caucasus range, are mainly migratory, and observations on their hibernation habits were made in 1949–53. The adult bugs leave the fields in July and fly south to the mountain forests. Aestivation merges into hibernation, with no great change in distribution of the insects [*cf.* **45** 304], but the bugs do not become completely immobile until the onset of winter. The weaker individuals do not penetrate beyond the foothills, the bulk of the population seeks the lower mountains, and the physiologically stronger bugs go still higher. The various biotopes concerned are described in detail. The return to the fields in spring is gradual, beginning in March or April and depending on temperature. Other populations overwinter in small numbers in forests in the lowlands, where they are exposed to excessive dampness and even flooding; these are thought to be physiologically weak populations or such as have been delayed in development.

Fedotov (D. M.) & Bocharova (O. M.). **Effect of the Preparation DDT and some organic Phosphorus Insecticides on** *E. integriceps* (pp. 238–275, 13 figs.). A detailed account is given of laboratory and field investigations in 1950–53 on the effect of DDT on *E. integriceps*, the main results of which have already been noticed [**42** 70–71; **44** 10]. Subsidiary laboratory tests were also carried out with several proprietary phosphorus preparations in sprays, including parathion. These were more rapid in action than DDT, and the pathological effects of both are attributed to a disturbance of cell metabolism due to the blocking of enzyme systems.

Walters (J.) & McMullen (L. H.). **Life History and Habits of** *Pseudohylesinus nebulosus* **(Leconte) (Coleoptera: Scolytidae) in the Interior of British Columbia.**—*Canad. Ent.* **88** no. 5 pp. 197–202, 4 figs., 6 refs. Ottawa, 1956.

Pseudohylesinus nebulosus (Lec.) occurs commonly in Douglas fir, *Pseudotsuga menziesii*, from British Columbia to Mexico and primarily infests thin-barked slash, although saplings are also attacked and sometimes killed by it [*cf. R.A.E.*, A **16** 93]. It is chiefly of importance as a competitor of *Dendroctonus pseudotsugae* Hopk., with which it is usually associated, and field and laboratory studies of its bionomics were accordingly made in the interior of British Columbia in 1955. Although Douglas fir is preferred, *Thuja plicata*, *Abies grandis*, *A. amabilis* and *Tsuga heterophylla* are also attacked on the coast and *T. heterophylla* and *Pinus ponderosa* in the interior of the Province. The construction of egg-galleries by paired adults began on 5th May, 12 days earlier than for *D. pseudotsugae*, and the number of fresh entries reached its peak on 8th May; there was none after 27th May, and until 9th May, attack was confined to slash from trees felled during the previous summer. The galleries were formed in the cambium, running vertically up and down from the entry hole, reached average and maximum lengths of 0·8 and 1·9 ins., respectively, and left the sapwood untouched. The eggs were laid singly in niches along the galleries, an average of about 18 in each gallery, and all the adults were dead by 13th July. The larvae hatched in about 15 days, and their feeding galleries began at right angles to the egg-gallery and then diverged; in the final (third) instar, they entered the inner bark. The larval and pupal stages lasted 41 and about 8 days, respectively, and the adults emerged between 15th August and 22nd September, with a peak on 27th August, in cages and from 24th August in the field. They fed and overwintered in niches bored in the bark of logs, which were sometimes extended to form galleries in which eggs were laid in the following spring.

Fox (C. J. S.) & MacLellan (C. R.). **Some Carabidae and Staphylinidae shown to feed on a Wireworm,** *Agriotes sputator* **(L.), by the Precipitin Test.**—*Canad. Ent.* **88** no. 5 pp. 228–231, 5 refs. Ottawa, 1956.

The following is almost entirely the authors' summary. In Nova Scotia, use of the precipitin test [*cf. R.A.E.*, A **43** 439] indicated that certain Carabids of the genera *Agonum*, *Amara*, *Clivina*, *Harpalus* and *Pterostichus* and Staphylinids of the genera *Philonthus*, *Staphylinus* and *Tachyporus* prey on wireworms in the field. Carabid and Staphylinid larvae and adults collected in all months except January, March and November from fields infested with wireworms were smeared on filter paper and tested against antiserum prepared from *Agriotes sputator* (L.), which was common in the area. The species of wireworms concerned could not be distinguished by the test, but refinement of the antiserum might make this possible.

Reeks (W. A.). **Sequential Sampling for Larvae of the Winter Moth,** *Operophtera brumata* **(Linn.) (Lepidoptera: Geometridae).**—*Canad. Ent.* **88** no. 6 pp. 241–246, 2 graphs, 9 refs. Ottawa, 1956.

A method of sequential sampling [*cf. R.A.E.*, A **44** 159] for the assessment of larval populations of *Operophtera brumata* (L.) on red oak (*Quercus borealis*) in Nova Scotia was developed from the results of population counts in 1952–55 [*cf.* **44** 227]. The data obtained refer to combined populations of *O. brumata* and *Alsophila pometaria* (Harris), of which *O. brumata* regularly comprised over 92 per cent. In 1953, 1954 and 1955, when defoliation on sample trees in an experimental plot averaged 78, 21 and 45 per cent., respectively, the average number of leaves per leaf cluster was 6·9, 5·6 and 5·2. The number of clusters per branch in the lower crown on severely defoliated trees averaged 26 in both 1954 and 1955, and the leaf cluster was adopted as the sampling unit; the sample comprised 12 leaf clusters taken from any part of each of eight trees [*cf.* **44** 227]. Sampling is best carried out when most of the larvae are in the fourth instar, which is usually in the second week of June on the south coast of Nova Scotia. Observations on individual trees for 2–4 consecutive years established that light, moderate and severe infestations, involving up to 12, 15–36 and over 42 larvae per tree sample, respectively, resulted in about 0–25, 35–80 and

90–100 per cent. defoliation by the end of the feeding period. This classification of infestations may not be applicable in cases of sustained attack or very recent infestation, where the leaves tend to be larger, but changes in the relationship would have to be considerable before it failed to accommodate them. The observed uniform defoliation within the crown of the trees and the solitary feeding habits of the larvae indicated a random distribution, which was confirmed by the relation between mean and variance for the larval count per leaf cluster. A table is given showing the limits in the cumulative numbers of larvae per tree sample within which infestation intensities intermediate between light and moderate and between moderate and severe are indicated, so that further sampling is necessary in order to classify the infestation more precisely. The usefulness of the method is demonstrated by an operating characteristic curve, which indicates that the risk of classifying a light infestation as severe is remote, and an average sample number curve, showing that it should rarely be necessary to sample more than eight trees.

Brown (N. R.) & Clark (R. C.). **Studies of Predators of the Balsam Woolly Aphid** *Adelges piceae* **(Ratz.) (Homoptera: Adelgidae). I. Field Identification of** *Neoleucopis obscura* **(Hal.),** *Leucopina americana* **(Mall.) and** *Cremifania nigrocellulata* **Cz. (Diptera, Chamaemyiidae).**—*Canad. Ent.* **88** no. 6 pp. 272–279, 23 figs., 7 refs. Ottawa, 1956.

In this first part of a series on the indigenous and introduced predators of *Chermes* (*Adelges*) *piceae* (Ratz.) on balsam fir [*Abies balsamea*] in eastern Canada, tables are given permitting the rapid differentiation of the native *Leucopis* (*Leucopina*) *americana* Mall. and the introduced *Leucopis* (*Neoleucopis*) *obscura* Hal. and *Cremifania nigrocellulata* Czerny [*cf. R.A.E.*, A **45** 379, etc.] in all their stages by means of characters visible for the most part with the aid of no more than a hand lens.

Rayner (A. C.). **Colorimetric Estimation of dyed Insecticide Spray Deposit using a Paper Sampling Surface.**—*Canad. Ent.* **88** no. 6 p. 279. Ottawa, 1956.

During spray trials against the European pine shoot moth [*Rhyacionia buoliana* (Schiff.)] in Ontario, a method for the intensive sampling and colorimetric estimation of deposits from dyed, oil-based insecticides was devised. Disks of filter paper, 9 cm. in diameter, stapled to flat cardboard were distributed over the test area, removed from the backing as soon as possible after spraying, to minimise fading, and loosely stacked. The dye was subsequently removed by shaking each paper in 10 ml. benzene in a colorimetric tube and the extract compared with standard ones by means of a Klett-Summerson colorimeter. The paper provided a satisfactory sampling surface for the spray used, which comprised a 10 per cent. dilution in fuel oil of a 25 per cent. DDT emulsion concentrate, with the addition of 0·5 per cent. red dye, and was applied at up to 2 gals. per acre. Comparison with deposits collected on glass indicated a reduction in optical density of about 1–2 per cent. in the deposits on the paper.

Narayanan (E. S.) & Subba Rao (B. R.). **Studies in Insect Parasitism I–III. The Effect of different Hosts on the Physiology, on the Development and Behaviour and on the Sex-ratio of** *Microbracon gelechiae* **Ashmead (Hymenoptera: Braconidae).**—*Beitr. Ent.* **5** no. 1–2 pp. 36–60, 7 figs., 26 refs. Berlin, 1955.

Bracon (*Microbracon*) *gelechiae* Ashm. was imported into India from Canada in 1944 for the control of the potato tuber moth (*Gnorimoschema operculella* (Zell.)) [*cf. R.A.E.*, A **37** 29] and is reared in large numbers in the laboratory on larvae of *Corcyra cephalonica* (Stnt.). The effect of other hosts on it was studied in experiments carried out at a constant temperature of 25°C. [77°F.] and an average relative humidity of 70 per cent. When the parasite was reared through six generations on *Scirpophaga nivella* (F.), *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) or *C. cephalonica* and 10 per cent. sugar solution was provided as food for the adults, the females survived for averages of about 30, 29 and 25 days, respectively, the total numbers of eggs laid per female averaged 220–434, 220–539 and 189–331, and the daily averages were 10, 13 and 10. Females of two generations reared on *Dichocrosis punctiferalis* (Gn.) lived for 18 and 20 days, respectively, and laid averages of 24 and 54 eggs each. Those of the second generation were allowed to oviposit on *C. cephalonica*, and the resulting females then laid 106 eggs each. The high percentage of protein and fat present in the larvae of *P. gossypiella*, which feed on cotton seeds, may be partly responsible for the increased fecundity of *B. gelechiae* reared on them. General observations indicated that larger females laid more eggs than smaller ones, irrespective of host, and that those reared on *S. nivella* or *P. gossypiella* were larger and had better developed ovaries than those reared on *C. cephalonica* or *D. punctiferalis*. The colour of the eggs of the parasite tended after several generations to resemble the colour of the host on which it had been reared.

In further experiments, the development of *B. gelechiae* from oviposition to adult emergence averaged nearly 10, 11, 12 and 15 days on *P. gossypiella*, *C. cephalonica*, *S. nivella* and *D. punctiferalis*, respectively, and although the numbers of eggs laid on *Plusia orichalcea* (F.) were much the same whether the host larvae fed on gram (*Cicer arietinum*) or tobacco, all the parasite larvae died in those developing on tobacco, except when the host larvae were very young, and mortality was even then rather high. This is attributed to accumulation of nicotine in the older hosts, which would be lethal to the parasites. In an olfactometer test carried out to determine whether the period for which the parasite was reared on laboratory hosts affected its natural host preference, nearly 73 per cent. of the females of a culture reared for seven years on *C. cephalonica* preferred that host to *G. operculella*, whereas over 64 per cent. of one reared for four generations on *S. nivella* preferred *C. cephalonica* to *S. nivella*. Statistical analysis showed both results to be highly significant.

When *B. gelechiae* was reared on *P. gossypiella*, *C. cephalonica* and *S. nivella*, the proportions of females produced in the population were about 55, 74 and 44 per cent., respectively, and similar results were obtained under mass rearing conditions. The size of the host bore little relation to the sex ratio of the parasite, and the high incidence of males in some hosts is attributed in part to a lack of external stimulation of the spermatheca in the ovipositing female, which depends on host suitability. Superparasitism also affected the sex ratio, by elimination of females. About 88 per cent. of the eggs laid by unfertilised females and about 56 per cent. of those laid by fertilised ones gave rise to adults; in the former case, these were all males, and in the latter, the ratio of males to females was about 1:3. Most of the mortality occurred in the larval stage. In a special test, the parasites were allowed to oviposit on first-instar larvae of *C. cephalonica*, which is a small host, so that superparasitism was more likely to give rise to high mortality. As the number of parasite larvae per host increased from 3 to 30, the proportion of females produced decreased from 73·6 to 9·8 per cent., whereas the total percentage of larvae that completed development fell from 53·1 to 22·8.

ZAHRADNÍK (J.). **Zur Nomenklatur von** *Quadraspidiotus mařani* **Zahradník** (*Quadraspidiotus schneideri* **Bachmann) (Homoptera: Coccoidea).** [On the Nomenclature of *Q. mařani.*]—*Beitr. Ent.* **5** no. 1–2 pp. 88–90, 12 refs. Berlin, 1955.

The author claims that *Quadraspidiotus schneideri* Bachmann is a synonym of *Q. mařani* Zahradník [*cf. R.A.E.*, A **42** 350; **45** 240], on the assumption that the original description of *Q. mařani* was published in October 1952, whereas that of *Q. schneideri* did not appear until December of the same year.*

DUPREE (M.), BISSELL (T. L.) & BECKHAM (C. M.). **The Pickleworm and its Control.**—*Bull. Ga agric. Exp. Stas* (N.S.) no. 5, 34 pp., 4 figs., 20 refs. Athens, Ga., 1955.

Diaphania nitidalis (Stoll), which occurs throughout the south-eastern United States, is the most destructive insect pest of cantaloupe melon, cucumber and squash in Georgia. All stages of this Pyralid are described, and an account is given of observations on its life-history and control carried out in 1945–53. These indicated that the insect does not overwinter in central Georgia, where its food-plants are absent in the cold season, but flies up from the south each spring; it is active on its wild and cultivated food-plants throughout the winter in southern Florida. The eggs are deposited singly or in groups on various parts of the plant, and the larvae burrow in the fruits and stems and also injure the flowers and leaves. They pupate in cocoons spun on the plant. The eggs hatched in 3–4 days in May–June, and the larval and pupal stages lasted 9–13 and 7–10 days, respectively; it was evident that at least four generations could develop in the season. Eggs were found in the field from May to 25th September, larvae from 18th May to 10th October, and pupae until 6th December, all stages being present in June–September. Adults that emerged in early December and were kept in outdoor cages were all dead by 11th December.

Infestation becomes heavier as the season progresses, so that early planting and harvesting help to reduce damage. A trap crop of squash, which is apparently preferred, did not afford satisfactory protection to cantaloupes, and no natural enemies were found. In insecticide tests in 1945–47, mainly on cantaloupe, cryolite was more effective when used undiluted than in 40–50 per cent. dusts, and 2 per cent. DDT was usually superior to cryolite when applied at similar rates and intervals, but was not entirely satisfactory and caused slight plant injury in some instances; the addition of nicotine, rotenone or pyrethrins to DDT did not improve control. Further tests with dusts were carried out on cantaloupe, squash and cucumber in 1949–53. Ryania and two mixtures of rotenone, pyrethrins and a synergist were all unsatisfactory. Dusts containing 3 and 5 per cent. purified DDT proved very effective and did not damage the plants when applied at about 20–30 lb. per acre 6–7 times at approximately weekly intervals, but even better control was given by 1 per cent. parathion or lindane [almost pure γ BHC], applied 3–7 times at rates of 14–50 and 11–46 lb. per acre, respectively; 9–31 lb. 1 per cent. EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] and 12–39 lb. 2–2·5 per cent. methyl-parathion were both very effective in tests in two years, but 20 lb. 4 per cent. malathion, tested in one year only, gave only fair control, and 11–15 lb. 2 per cent. methoxy-DDT (methoxychlor) and 10–14 lb. 1·5 per cent. Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] each gave poor control when applied about 6 times, also in one year only.

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* We are informed by Bachmann that the part of *Mitt. schweiz. ent. Ges.* containing his formal description of *Q. schneideri* [*R.A.E.*, A **42** 350], which bore the date 17th December 1952, was published on 19th December, and by the editor of *Beitr. Ent.* that the part of that journal containing Zahradník's description of *Q. mařani* [**42** 350], though dated October 1952, did not in fact appear until 20th December. *Q. schneideri* thus has priority.—*Ed.*

In general, insecticide treatments were found to be most effective when begun at the flowering stage and repeated at intervals of about 5–7 days; a minimum of six applications was usually needed for good control, the amount of insecticide varying according to plant size, but being usually about 15–25 lb. per acre.

DDT damaged cantaloupe plants in greenhouse tests, aldrin caused severe injury to cucumber during dry weather, and methyl-parathion scorched the leaves of squash when applied in the presence of dew in one test, but did not reduce the yield. In several tests, heavy infestation by Aphids followed the use of cryolite, DDT and Dilan; EPN resulted in an increase of the potato Aphid [*Macrosiphum solanifolii* (Ashm.)] on squash, but not of the melon Aphid [*Aphis gossypii* Glov.] on cucumber, and the other materials permitted no increase.

Simons (J. N.). **The Pepper Veinbanding Mosaic Virus in the Everglades Area of South Florida.**—*Phytopathology* **46** no. 1 pp. 53–57, 4 figs., 9 refs. Baltimore, Md., 1956.

A virus disease of bell peppers (*Capsicum*) believed not to have been reported previously was prevalent in the Everglades area of southern Florida in the spring of 1954, the main symptom of infection being vein-banding. Investigations on the physical properties, host range and transmission of the virus were carried out, and *Zinnia* and *Portulaca oleracea* were found to be susceptible to it, in addition to several solanaceous plants. Nightshade (*Solanum gracile*) was found to be a naturally infected weed source. *Myzus persicae* (Sulz.) and *Aphis gossypii* Glov. both transmitted the virus efficiently to healthy pepper plants in the greenhouse, but *Aphis fabae* Scop. (*rumicis*, auct.) failed to transmit it. *M. persicae* acquired the virus in feeding periods of five seconds or less. Naturally terminated feedings resulted in a higher proportion of infections than did artificially terminated ones, but differences were apparent only during the first 15 seconds of feeding time. It also transmitted the virus in feeding periods of five seconds or less, and prolonging the test feeding beyond five minutes resulted in only a slight increase in amount of transmission. Starvation for two minutes following acquisition caused a noticeable drop in infectivity, and starvation for an hour in almost complete loss of the virus, which is therefore classified as non-persistent.

Freitag (J. H.). **Beetle Transmission, Host Range, and Properties of Squash Mosaic Virus.**—*Phytopathology* **46** no. 2 pp. 73–81, 1 fig., 22 refs. Baltimore, Md., 1956.

A mosaic disease of squash is common in the coastal regions and also occurs in the interior of California, and investigations on the properties, host range and transmission of the causal virus are here recorded. Its host range included plants in several families, but it caused distinct symptoms only in cucurbits, of which 11 species proved susceptible to infection.

In tests on insect transmission, nine species of Aphids, including four that occur on squash in the field, five Cicadellids, *Anasa tristis* (Deg.) and *Lygus* sp. all failed to transmit the virus from infected to healthy squash, but it was transmitted by adults of *Acalymma trivittata* (Mannh.) and, less readily, *Diabrotica undecimpunctata* Mannh. *A. trivittata* acquired the virus in feeding periods of five minutes after starving for three days, and acquired and transmitted it in less than ten hours. When transferred daily to healthy squash plants, infective adults of *A. trivittata* retained the virus for 17 days, and those of *D. undecimpunctata* for 20. One example of *A. trivittata* infected 9 of 28 plants in daily transfers. Fluid regurgitated by the beetles after feeding on infected plants was found to be highly infectious, which suggests that regurgitation is the most likely source of virus in transmission. The virus was recovered from the excreta, the body fluid and the crushed bodies of the beetles.

Since Doolittle's report of the transmission of the virus of cucumber mosaic by cucumber beetles [*R.A.E.*, A **9** 306] has apparently received no published confirmation, *A. trivittata* and *D. undecimpunctata* were tested as possible vectors of this virus. Adults of *A. trivittata* were allowed to feed for several days on squash plants infected with various strains of western cucumber mosaic, and were then transferred in groups of 2–10 to healthy plants, or for one day on plants infected with common cucumber mosaic, after which they were transferred in groups of 5–23 to healthy plants. No transmission resulted, and batches of 5–10 adults of *D. undecimpunctata* also failed to transmit cucumber mosaic to any of the plants on which they fed. In view of these results, Doolittle's finding requires substantiation.

MARAMOROSCH (K.). **Semiautomatic Equipment for injecting Insects with measured Amounts of Liquids containing Viruses or toxic Substances.** —*Phytopathology* **46** no. 4 pp. 188–190, 1 fig., 12 refs. Baltimore, Md., 1956.

The apparatus described permits the semi-automatic injection of small amounts of liquid into insects under carbon-dioxide anaesthesia. It has proved useful for the injection of virus material into Cicadellids [*cf. R.A.E.*, A **45** 201, 202, 476].

DICKSON (R. C.), JOHNSON (M. McD.), FLOCK (R. A.) & LAIRD jr. (E. F.). **Flying Aphid Populations in southern California Citrus Groves and their Relation to the Transmission of the Tristeza Virus.**—*Phytopathology* **46** no. 4 pp. 204–210, 1 graph, 7 refs. Baltimore, Md., 1956.

The following is virtually the authors' summary. Populations of flying Aphids in southern California *Citrus* groves from 1951 to 1954 were determined by trapping with sticky boards. *Aphis spiraecola* Patch made up about 85 per cent. of the catch. *A. gossypii* Glov. constituted only 3 per cent. of the catch, but the 35,000 examples of this Aphid recorded as flying to each *Citrus* tree each year in the area of the most rapid spread of the tristeza (quick decline) virus were more than enough to account for the spread of this disease [*cf. R.A.E.*, A **39** 307; **44** 330], even though the transfer of an average of 5,600 examples of *A. gossypii* was required to produce infection in experimental work. The spread of tristeza in the groves seldom exceeded the rate of two new infections each year from each diseased tree present. The tristeza virus was shown to be non-persistent in its vector and to be carried only by *A. gossypii* in this area, at least at a demonstrable level of efficiency [*cf.* **44** 330].

Maramorosch (K.). **Two distinct Types of Corn Stunt Disease in Mexico.** (Abstract.)—*Phytopathology* **46** no. 4 p. 241. Baltimore, Md., 1956.

A field survey in Mexico revealed the presence of two distinct types of stunt disease of maize [*cf. R.A.E.*, A **42** 267]. The type designated as Rio Grande corresponds to the stunt previously reported from California and Texas. It was found for the first time in Mexico, in the south (Oaxaca), north (Ciudad Victoria), and east (Vera Cruz). The type designated as Mesa Central, known previously from the central plateau and Gulf coast regions, was also found on the Pacific coast. The characteristic features of the Rio Grande type are interrupted chlorotic streaks on leaves and numerous secondary shoots. In the Mesa Central type, the chlorotic spots are absent or are less conspicuous than in the Rio Grande type. The Mesa Central disease causes red to purple discoloration of the leaves and more branching at the base and more stunting than does the other type. When several commercial varieties of maize were infected by means of the vector *Dalbulus maidis* (De Long & Wolc.), the symptoms of each type were consistently reproduced, irrespective of the variety used, and *D. maidis* proved an efficient vector for both types. Whether the two types of disease are caused by strains of the same virus or by two unrelated viruses has not yet been established.

Jewell (F. F.). **Insect Transmission of Oak Wilt.**—*Phytopathology* **46** no. 5 pp. 244–257, 18 figs., 40 refs. Baltimore, Md., 1956.

Oak wilt, which is caused by the fungus, *Endoconidiophora fagacearum*, was first found in West Virginia in 1951, when a preliminary survey revealed infected oak trees in three districts. The author records investigations on the relation of Nitidulids to the spread of the disease and on the habits of these beetles, most of which has already been noticed [*cf. R.A.E.*, A **45** 189–190]. In transmission experiments, carried out in 1953–54, in which beetles contaminated by feeding on fungus cultures were transferred to uninfected wounds on healthy trees, the fungus was transmitted to the latter by *Glischrochilus sanguinolentus* (Ol.), *Colopterus semitectus* (Say), *Carpophilus lugubris* Murr. and a mixed batch of *C. lugubris* and *G. confluentus* (Say). The fungus was isolated from the excreta of infected beetles, and aqueous suspensions of such excreta proved infective when injected into fresh tree wounds. There is an apparently symbiotic relation of long standing between the Nitidulids and two other species of fungi [*cf.* **45** 190], which they disseminate and on which they feed. *E. fagacearum* has apparently only recently become a member of this complex, and its distribution may be expected to increase unless control measures are adopted.

Freitag (J. H.). **Western Aster Yellows Virus Infection of Squash, Pumpkin, and Cucumber.**—*Phytopathology* **46** no. 6 pp. 323–326, 1 fig., 8 refs. Baltimore, Md., 1956.

The virus of aster yellows is known to have a wide range of host-plants, and symptoms of infection by it have been observed for several years on squash and pumpkin in the Sacramento Valley of California. In experiments, males of *Macrosteles fascifrons* (Stål) reared on *Plantago major* infected with a western strain of the virus transmitted it to healthy squash, pumpkin and cucumber plants, and others that fed on field-grown squash plants suspected of being infected transmitted it to healthy *Plantago*. *Colladonus montanus* (Van D.) transmitted it from naturally infected squash to celery, and examples of this Cicadellid taken in a field of squash were found to be naturally infected with the virus, which they transmitted to healthy squash on which they fed. The symptoms caused by the virus in cucurbits are described; the latter seem to constitute a relatively new group of host-plants to show high infection in the field, but this might be explained by the recent occurrence of environmental conditions unusually favourable to the Cicadellid vectors.

Smalley (E. B.). **The Production on Garlic by an Eriophyid Mite of Symptoms like those produced by Viruses.**—*Phytopathology* **46** no. 6 pp. 346–347, 1 fig., 1 ref. Baltimore, Md., 1956.

Symptoms resembling those sometimes caused by viruses, but differing in some respects, were observed in many plantings of garlic in California in 1954 [*cf. R.A.E.*, A **44** 388]. They were found to be associated with infestation by *Aceria tulipae* (Keifer), which was present in large numbers on affected plants. Examination of garlic bulbs from local stores showed that all were infested by this mite, which was evidently more widespread than had been realised. When uninfested young plants growing in pots were infested with *A. tulipae* from field-infested plants or stored garlic, typical symptoms developed. The almost mature bulbs were removed from the pots, disinfested and planted in the following spring. The resulting plants showed no symptoms, indicating that the condition is due to feeding by the mites and not to a virus.

Shepherd (R. J.) & Struble (F. B.). **Tobacco Ringspot Virus on Watermelon.**—*Phytopathology* **46** no. 7 pp. 358–362, 3 figs., 12 refs. Baltimore, Md., 1956.

A pimple disease of watermelons that is common in Oklahoma and is characterised by the appearance of small swellings on the surface of the fruits was found to be caused by a virus that was identified as a yellow strain of the tobacco ringspot virus. Studies on its properties and host range and of tests of transmission by means of insects are described. In the latter, the virus was transmitted from infected watermelon to one of 48 healthy plants by examples of *Melanoplus differentialis* (Thos.) that had previously fasted for 24–36 hours, so that these grasshoppers may be occasional vectors in the field, but *Aphis gossypii* Glov. failed to effect transmission.

Takeshita (R. M.). **Identity of the Oat Red-leaf Virus with the Barley Yellow-dwarf Virus.**—*Phytopathology* **46** no. 8 pp. 436–440, 25 refs. Baltimore, Md., 1956.

Red leaf is a virus disease of oats that has caused losses of yield in many parts of the United States. An Aphid-borne virus disease named yellow dwarf has recently been described from barley and other cereals there and it causes symptoms on oats similar to those of red leaf [*cf. R.A.E.*, A **43** 268]. Investigations were therefore carried out on the relation of the two diseases to one another. It was found that red leaf could not be transmitted through seed or soil or by mechanical means. In tests with Aphids, *Rhopalosiphum prunifoliae* (Fitch) and *Macrosiphum avenae* (F.) (*granarium* (Kby.)) from oats infected with red leaf in the greenhouse transmitted the virus to 12 and 16 of 20 healthy oat plants to which they were transferred in batches of 3–5, and Aphids collected on infected oats in the field in Illinois transmitted it to oats, wheat, barley and rye, the incubation period being 2–3 weeks. Oats developed a typical reddening of the leaves, barley and wheat a moderate yellowing of the leaves and stunting, and rye a slight stunting. Virus-free Aphids of the species *R. prunifoliae*, *M. avenae*, *Aphis* (*M.*) *maidis* Fitch and *Toxoptera graminum* (Rond.), all of which have been reported to transmit yellow dwarf [*loc. cit.*], recovered the virus from oats infected with red leaf and transmitted it to oats, barley, wheat and rye, the symptoms varying somewhat according to the place of origin of the virus, and the efficiency of transmission varied from 16 to 100 per cent., depending on the Aphid used and the conditions. The red-leaf virus persisted in *M. avenae* and *R. prunifoliae* for 15 days, the maximum tested, and the yellow-leaf virus has been reported to persist in its Aphid vectors for at least five days [*loc. cit.*]. Virus isolated from barley and wheat showing yellow-dwarf symptoms appeared identical with that from oats showing red leaf, and it is concluded as a result of the work that the two described diseases are caused by one and the same virus.

WEBB (R. E.). **Relation of Temperature to Transmission of the Potato Leafroll Virus.** (Abstract.)—*Phytopathology* **46** no. 8 p. 470. Baltimore, Md., 1956.

Aphids (*Myzus persicae* (Sulz.)) were reared at 22 and 27°C. [71·6 and 80·6°F.] on potato plants infected with leaf-roll virus, and adult apterae were transferred singly with a camel-hair brush to individual plants of *Physalis floridana* and allowed to feed for three days. In four separate trials, 208 indicator plants were infested at 27°C. and 217 were infested at 22°C., and the percentages that became infected were 58 at 27°C. and 26 at 22°C. When individual Aphids were transferred from the virus-infected plants at 27°C. to 114 indicator plants at 22°C., 50 per cent. of the latter became infected, and when they were transferred from the virus-infected plants at 22°C. to 105 indicator plants at 27°C., 32 per cent. of the latter became infected. In a further test, 20 potato plants of each of three varieties were infested with 15 viruliferous Aphids per plant from infected plants at 22 and at 27°C., and the numbers of plants that became infected were 11, 17 and 0, respectively, at 22°C. and 16, 20 and 18 plants at 27°C. High temperature apparently influenced the number of infective Aphids and lowered the resistance of the potato.

LIENK (S. E.) & others. **Taste Evaluation of Apples treated with the Acaricide Ovex.**—*Agric. Chem.* **11** no. 12 pp. 46–48, 117, 2 refs. Baltimore, Md., 1956.

In the experiments described, apple trees of six varieties in four localities in the United States were sprayed in 1954 with 50 per cent. wettable ovex (p-chlorophenyl p-chlorobenzene sulphonate) at 0·25 lb. per 100 U.S. gals. in the pre-bloom spray, where this was applied, and at 0·5 lb. in subsequent ones. Trees in Indiana received six applications from April, trees in Ohio and New York four from May and June, respectively, and trees in Michigan four from June or five from May, usually in alternate applications of a general spray, which included an organic fungicide and an insecticide (DDT or lead arsenate) and was applied at intervals of 10–14 days. Totals of 32–40 oz. 50 per cent. powder per acre were applied by the middle of August and the fruit was harvested between late September and mid-October. It showed residues of 0·08–1·17 parts per million ovex before being processed into apple sauce and, with one possible exception, none after; the present tolerance of ovex residues on fresh fruits in the United States is 3 p.p.m. Processed samples of treated and untreated fruits showed differences in taste in some instances, but the results were inconsistent, and the variations found are believed to be due to factors other than treatment with ovex; no objectionable flavours were detected.

MacCollom (G. B.). **Effects and Correction of DDT Phytotoxicity to Cucumbers.**—*Mem. Cornell agric. Exp. Sta.* no. 339, 48 pp., 7 figs., 45 refs. Ithaca, N.Y., 1956.

The following is based on the author's summary. From the time of the earliest experiments with DDT, its phytotoxicity to cucurbits has been apparent [*R.A.E.*, A **34** 338; **35** 159; **37** 250, 416]. In tests begun in New York in 1951, the incorporation of activated charcoal was found very effective in reducing the injury caused by dusts [**43** 43], and field tests were made in 1952–53 to compare the effects of varying ratios of activated charcoal. In 2 per cent. DDT dusts, the addition of charcoal to technical DDT in the ratio of 3:1 and to a wettable powder formulated on ground tobacco stems in the ratio of six parts charcoal to one part actual DDT gave the best results, but there was no lessening of injury when charcoal was added to purified DDT, which is less phytotoxic than the technical product. The inclusion of activated charcoal in wettable-powder sprays failed to reduce the injury, and the use of Triton B-1956 [a modified phthalic glycerol alkyd resin] as an adhesive and spreader increased it. When soybean flour was substituted for B-1956, the effect on the plants was similar to that of DDT without additives. The 2 per cent. DDT dust with charcoal caused a significant increase in yield on four of five varieties of cucumber.

In greenhouse tests, the injury due to technical DDT was found to be primarily associated with the o,p′ and p,p′ isomers [*cf.* **43** 43], the first of these being twice as phytotoxic as the second, and in laboratory tests, the addition of activated charcoal to DDT in sprays reduced its contact toxicity to larvae of *Laphygma* (*Prodenia*) *eridania* (Cram.) and to *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) but not its stomach action on *L. eridania*.

MacLagan (D. S.). **Effects of modern Insecticides on Growth of Plants.**—*Nature* **179** no. 4571 pp. 1197–1198, 2 graphs, 5 refs. London, 1957.

During work to determine the maximum dosage of insecticide that can be applied to seeds without subsequent phytotoxic effects, the seeds of swede, parsnip, beet, bean and mangold were observed in field tests to germinate faster after treatment than untreated seeds and to produce better plant stands, despite the apparent absence of insect attack. In further investigations, parsnip seeds treated with γ BHC at 2 or 2·5 per cent. by weight or with dieldrin at the higher dosage were germinated in sterilised compost between glass plates in the laboratory. All the dressings caused phytotoxic effects that persisted for 14 days, but there was a subsequent stimulant effect on root growth from 2 per cent. γ BHC, though not from 2·5 per cent. γ BHC or dieldrin. There was no significant difference in the mean root length of parsnip seedlings grown in experimental plots from treated and untreated seed, but treatment with 2 per cent. γ BHC quadrupled the percentage of seedlings with roots exceeding 7 ins. in length, doubled the proportion in which the root was only 4–5 ins. long and decreased the proportion with roots of intermediate lengths, and 2 per cent. dieldrin increased the proportion of roots of intermediate lengths. In similar experiments with mangold seeds treated with γ BHC, dieldrin and aldrin at 0·35 per cent. (which provided the same amount of toxicant per seed as the 2 per cent. dressing on parsnip seeds), all the materials increased mean root length in the laboratory, but whereas the action of γ BHC was initially weak and subsequently became intensified, the reverse was true of dieldrin and aldrin. In the field, γ BHC again exerted some differential effect, and there were indications of slight increase in yield depending on the proportion of seedlings that were stimulated. It is suggested that the beneficial effects on cereals of seed dressings applied against wireworms and Tipulid larvae at concentrations as low as 0·06 per cent. and not entirely attributable to insecticidal action [*cf. R.A.E.*, A **40** 216] may be due to a stimulant effect on plant growth.

Holmes (N. D.) & Farstad (C. W.). **Effects of Field Exposure on immature Stages of the Wheat Stem Sawfly, *Cephus cinctus* Nort. (Hymenoptera: Cephidae).**—*Canad. J. agric. Sci.* **36** no. 3 pp. 196–202, 1 graph, 6 refs. Ottawa, 1956.

Shallow cultivation in autumn or spring to expose wheat stubs infested by overwintering larvae of *Cephus cinctus* Nort. has been recommended for the control of this sawfly in Canada [*cf. R.A.E.*, A **29** 112; **36** 390], but since rainfall during the exposure period may nullify the effects of desiccation and some larvae may re-enter diapause if exposed to hot, dry conditions in spring [*cf.* **37** 126; **45** 55], the relation between the date and the effectiveness of exposure was investigated.

In a test of spring exposure in Saskatchewan in 1948, stubs were dug up every 2–4 days between 9th May and 4th June and on 19th June, and left on the soil. Sample stubs were split at regular intervals until 9th July, when those remaining were stored at 0°C. [32°F.] to eliminate the induced diapause in the surviving larvae. During the exposure period, the maximum daily temperature at the surface of the soil ranged from 75 to 120°F., the maximum daily air temperature ranged from 53 to 90°F. in May and from 59 to 93°F. in June, and precipitation in the two months amounted to 0·03 and 2·01 ins. Pupae were first found on 25th May, and larvae, which, with prepupae, predominated until 28th May, comprised only 3 per cent. of the population by 4th June. The date of exposure was more important than its duration. Larval survival decreased progressively from 35 per cent. after exposure on 9th May to 1 per cent. after exposure on 4th June, and mortality was over 90 per cent. in stubs first exposed between 25th May and 4th June, when most individuals were in the prepupal or pupal stages. A short period of exposure caused considerable mortality among sawflies first exposed in these stages, even though the temperature was not excessively high and there was some precipitation. Most of the larvae that survived exposure gave rise to adults, in which, however, the bodies and wings were abnormally short. Adults emerged from 17 per cent. of the stubs exposed on 19th June. A consideration of the meteorological data during the exposure period and the findings of previous investigators [**36** 391; **45** 56] indicated that temperature was the main factor operating during the first part of the exposure period, though it is not known whether that or desiccation was the major cause of mortality, and that desiccation was the major factor during 20th–26th June, although considerable rain fell during this period.

The value of autumn exposure was investigated in the same year in Alberta, where stubs were dug up and exposed on seven dates between 14th August and 29th September; samples were examined at weekly intervals until 1st October, and the rest were left on the ground until 3rd June 1949. Between 14th August and 1st October, there was no precipitation and the maximum temperature at the surface of the soil ranged from 74 to 127°F.

The percentage mortality was relatively high (60) among larvae exposed on 14th August, when a temperature of 127°F. occurred and many larvae had cut the stems but not yet formed their cocoons, but mortality in stubs exposed after that date was only 21–28 per cent. By the following June, mortality was complete or virtually so in all the plots, which included both spring- and winter-sown wheat, although weather conditions during the winter were not unusually severe and in spring were more favourable for the sawfly than they had been in Saskatchewan. It is concluded that most mortality occurred during the winter, and that excellent control can be obtained by exposure at any time during the autumn. Spring exposure should be limited to the latter part of May and early June, when most of the population is in the prepupal or pupal stage.

Read (D. C.). **An Apparatus for removing Puparia and Larvae from Soil.**—*Canad. J. agric. Sci.* **36** no. 3 pp. 205–207, 1 pl., 1 ref. Ottawa, 1956.

The following is based almost entirely on the author's abstract. An apparatus designed for the separation of root-maggot puparia from wet or dry soil is described. Infested soil is washed through two screens of different meshes placed one above the other over a water tank. Soil masses are broken up by brushes moved across the upper screen, on which large débris is retained. The lower screen is vibrated manually and retains the puparia and débris of a similar size. The puparia are then floated off in clear water and collected with a piece of screen wire; larvae can be removed from the débris with forceps. Puparia of *Hylemyia brassicae* (Bch.) added to soils of different types in batches of 100 were all removed by means of the apparatus, and adults subsequently emerged from 95 per cent. of them.

Willison (R. S.) & Dustan (G. G.). **Fruit Flies and fungal Wastage in Peaches.**—*Canad. J. agric. Sci.* **36** no. 3 pp. 233–240, 1 ref. Ottawa, 1956.

The following is based almost entirely on the authors' summary. In experiments in Ontario during 1953–55, infestation of harvested peaches by mixed batches of *Drosophila melanogaster* Mg., *D. buscki* Coq., *D. repleta* Woll. and *D. immigrans* Sturt. was found to increase both the incidence and the rate of development of brown rot (*Sclerotinia* (*Monilinia*) *fructicola*) and black mould (*Rhizopus nigricans*) on the fruits when external sources of inoculum were available. In the absence of *Drosophila*, the presence of inoculum sources within 2 ft. of baskets of test fruits had no consistent effect on the incidence of wastage. The percentages of brown-rot attacks starting at the stem end in the absence and presence of *Drosophila* were, respectively, 44 and 60 in the Veteran variety and 66 and 84 in Elberta, which is very susceptible to stem-end injuries at harvest. The incidence of brown rot was somewhat lower in fruit from trees sprayed with sulphur than from those sprayed with captan (N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide), and the sulphur also appeared to have some repellent effect on the flies. Black mould usually did not appear until the fruit was ripe, and it was carried very efficiently by *Drosophila* from outside sources of inoculum. If black-mould inoculum was present on the test fruits when picked, but not in the external source, the flies had little effect on its dissemination. Under these conditions, fruits that had been sprayed with captan were better protected than those sprayed with sulphur.

Miller (L. A.). **Insecticides and varietal Resistance in the Control of the Squash Vine Borer,** *Melittia cucurbitae* **(Harr.), in southwestern Ontario.**—*Canad. J. agric. Sci.* **36** no. 4 pp. 309–313. 6 refs. Ottawa, 1956.

The following is largely based on the author's abstract. In experiments in south-western Ontario in 1952 and 1954 with a variety of squash highly susceptible to attack by *Melittia cucurbitae* (Harr.) dusts of 2·5 per cent. aldrin, 1 or 2·5 per cent. dieldrin, 3 per cent. methoxy-DDT (methoxychlor) or 3 per cent. aerosol-grade DDT applied about the time of adult emergence [*cf. R.A.E.*, A **45** 256] each gave excellent protection against infestation. A dust of 1 per cent. rotenone with a fungicide was moderately effective. Three applications, the first during the last week of June and the others at intervals of 7–10 days, made at rates varying from 10–15 lb. per acre for the first application to 30–40 lb. per acre for the last, were adequate. The dusts should be directed to the bases of the stems, where 85 per cent. of the eggs are laid. All the materials reduced oviposition, and all also controlled the striped cucumber beetle [*Acalymma vittata* (F.)] and *Diabrotica undecimpunctata howardi* Barber. None of the dusts damaged the plants. Observations on the susceptibility to attack by *M. cucurbitae* of various species and varieties of cucurbits are recorded.

Busvine (J. R.). **A critical Review of the Techniques for testing Insecticides.**—10¼ × 7 ins., ix + 208 pp., 50 figs., 555 refs. London, Commonw. Inst. Ent., 1957. Price 30*s*.

Strains of injurious insects and other arthropods resistant to toxic materials applied against them have steadily become more numerous during the past ten years and have been reported in over 30 pests in different parts of the world. It is clear that the number of species that escape control because of resistance is increasing from year to year, and the specific and basic research necessary if this trend is to be arrested is hampered by a lack of satisfactory techniques for the precise measurement of resistance. The author therefore reviews, from the entomological and other literature published up to the spring of 1957, methods that have been devised for laboratory tests of insecticides and acaricides for the control of pests of medical, veterinary and agricultural importance. All stages of the techniques are dealt with in a comprehensive manner, and information on chemical, physical, mechanical and other factors that influence the results and methods for determining their effect are in many cases included. An introductory chapter on the choice of method for the measurement, for different purposes, of toxicity in materials applied for control and susceptibility in arthropods, is followed by two on methods of handling test arthropods and their physiological standardisation. A further two chapters are devoted to apparatus and procedure for tests of sprays and aerosols and for the injection and topical application of insecticides, six to techniques for testing the various types of toxic materials, classified according to their mode of action, and one to statistical procedure. The chapter on stomach poisons includes information on apparatus for the application of dusts and on techniques for tests of materials applied to leaves and textiles, in baits, or mixed with food or breeding media, and of systemic insecticides and acaricides applied to plants and to domestic and laboratory animals. Materials possessing contact toxicity are the subject of three chapters, of which one includes techniques for basic studies of their action and for tests of their effectiveness, one on residual action contains a review of methods for their application as films and the subsequent evaluation of their toxicity, and the third is chiefly concerned with techniques for materials applied against mosquito larvae, but also includes some information on dipping techniques for Aphids and a few other insects of agricultural importance. Fumigants and repellents are dealt with in the remaining two chapters. In a brief conclusion, the author stresses the need for the development and general adoption of simple, but sound, techniques and the desirability of standardisation in methods for assessing resistance.

GEORGHIOU (G. P.). **Control of "Medfly" on Apricots.**—*Countryman* Sept. 1956 p. 18. Nicosia, 1956.

The Mediterranean fruit-fly [*Ceratitis capitata* (Wied.)] is a serious pest of apricots in most areas of Cyprus. A large-scale control demonstration was organised in June–July 1956 in a district in which up to 30 per cent. or more of the late-maturing fruits are commonly infested, the method used being the same as that employed for bait-sprays on *Citrus* in 1955 [*cf.* *R.A.E.*, A **45** 461]. A bait-spray of 1 per cent. malathion in 10 per cent. sugar solution was applied in several orchards to a patch of foliage on each tree 2–3 times at intervals of about ten days and resulted in the total prevention of infestation, which reached 2–6 per cent. on untreated trees, the fruit-fly population being unusually low.

HAMMAD (S. M.). **Further Additions to the Knowledge of some Leaf-miners from Egypt (Lepidoptera and Diptera).**—*Bull. Soc. ent. Egypte* **40** pp. 21–27, 2 figs., 7 refs. Cairo, 1956.

Records are given of eight more leaf-miners observed near Alexandria [*cf.* *R.A.E.*, A **45** 167]; those that attacked plants of economic importance comprise *Acrocercops conflua* Meyr. on castor (*Ricinus communis*), *Lyonetia clerkella* (L.) on apple, plum, quince and rose and rarely on pear, *Tylomyza pinguis* (Fall.) on lettuce, and *Pseudonapomyza atra* (Mg.) on maize, wheat and barley. The mines and the way in which the frass is disposed in them are described and illustrated.

EL-SAWAF (S. K.). **Some Factors affecting the Longevity, Oviposition, and Rate of Development in the Southern Cowpea Weevil,** *Callosobruchus maculatus* **F. (Coleoptera: Bruchidae).**—*Bull. Soc. ent. Egypte* **40** pp. 29–95, 1 fig., 57 refs. Cairo, 1956.

The laboratory observations here described on the effects of various factors on the bionomics of *Callosobruchus maculatus* (F.) were begun with a stock obtained from infested cowpeas from Upper Egypt in September 1951. On cowpeas, 11 generations developed between April 1952 and May 1953, and the progeny of eight females and 15 males destroyed more than half of about 2 lb. cowpeas in three months [*cf.* *R.A.E.*, A **29** 58, 321]. When newly emerged adults that had been reared at 25°C. [77°F.] and 75 per cent. relative humidity were kept at constant temperatures of 18–35°C. [64·4–95°F.] and relative humidities of 55–90 per cent., the mean length of life decreased from about 24 days at 18°C. to about 7 at 35°C. for females, males surviving for slightly less, and the mean number of eggs laid per female were about 50 at 18°C., 80 at 25°C. and 54·5 at 35°C. Increased relative humidity slightly increased adult life and the number of eggs laid. When the insects were reared to maturity at constant temperatures of 21, 25 and 31°C. and relative humidities of 55, 65 or 75 per cent. and were kept at 25°C. and 75 per cent. relative humidity during adult life, raising the rearing temperature slightly decreased the survival period of the adults and reduced the number of eggs laid, but changing the humidity had no effect.

When the Bruchid was reared on other leguminous seeds, adults from soy beans had significantly shorter lives than any others, and those from *Dolichos lablab* and peas tended to have shorter lives than those from broad beans (*Vicia faba*) or chick-peas (*Cicer arietinum*). The mean number of eggs laid per female was greatest (75) for those reared on *C. arietinum* and least on soy bean. On cowpeas, more eggs were laid on sound than on broken seeds, and unfertilised females laid very few eggs, none of which hatched. The development of the immature stages was also dependent on temperature, the mean durations of the egg stage and the combined larval and pupal stages falling from 20·7 and 119·2 days at 18°C. to 3·7 and 15·3 days at 35°C., but varied little with relative humidities of 55–90 per cent. The percentage of adult emergence increased with rising temperature, and was little affected by relative humidity unless this was high enough to favour the growth of fungi. Males were slightly more numerous than females under all conditions, and the reproductive rate was greater when 16 pairs of adults were confined with 90 cowpea seeds than at higher or lower population densities.

Habib (A.). **The Male** *Eulecanium corni* **Bouché (Hemiptera-Homoptera: Coccoidea-Coccidae).**—*Bull. Soc. ent. Egypte* **40** pp. 119–126, 5 figs., 9 refs. Cairo, 1956. *Eulecanium taxi* **nov. spec. (Homoptera: Coccoidea-Coccidae).**—*T. c.* pp. 453–462, 6 figs., 10 refs.

In the second of these papers, the author describes all stages of *Eulecanium taxi*, sp.n., from yew (*Taxus baccata*) in southern England [*cf. R.A.E.*, A **45** 164], and gives characters distinguishing it from the other species of the genus, especially *E. corni* (Bch.). Observations on its bionomics [*cf. loc. cit.*] showed that the females laid 152–543 eggs each, beginning about mid-May. The crawlers hatched in June and migrated to the tips of the twigs, where they fed on both surfaces of the leaves. They congregated on the undersides of the leaves, leaf-stems and twigs within 1–2 weeks and moulted about mid-August, after which there was little movement, and again in April. The males, which comprised about 2 per cent. of the population, pupated towards the end of April and emerged in the first half of May, and the females reached full size a few days after the second moult.

In the first paper, the author points out that the males from *T. baccata* described by Gimingham [**22** 173] were in reality *E. taxi* and states that he found males of *E. corni* in southern England only on *Cotoneaster microphylla*. The puparium, prepupa, pupa and adult male are described. Males comprised not more than 5 per cent. of the population; the second-stage nymphs formed puparia from the beginning of April and transformed to adults in late April or early May. In the laboratory, males of *E. corni* developed on plants other than *Cotoneaster*; fertilised females produced young of both sexes and unfertilised ones females only. Attempts to mate males of either species with females of the other were unsuccessful.

Soliman (A. A.). **On the Control of the Olive-tree Scale,** *Leucaspis riccae* **Targ., at Burg El-Arab, Egypt (Hemiptera: Coccoidea).**—*Bull. Soc. ent. Egypte* **40** pp. 207–215, 1 fig., 11 refs. Cairo, 1956.

Olive trees have been successfully introduced into the desert area of Burg El-Arab, about 30 miles west of Alexandria, but are severely attacked by *Leucodiaspis* (*Leucaspis*) *riccae* (Targ.), which has one generation a year there. The recommended spray of 1·75 per cent. oil emulsion afforded poor control, and the author describes experiments in which sprays of parathion and Tetrax [a preparation containing schradan] were compared with it. Parathion proved the most toxic and did not damage the trees. One application at 0·08 per cent. was more effective than one at 0·01–0·04 per cent., but less so than two at 0·04 per cent., which gave 90 per cent. kill. Applications are best made in April–June, when the crawlers appear, and 2–3 at a concentration of 0·04 per cent. are recommended. Tetrax gave fair control and was superior to oil emulsion.

HAFEZ (M.) & OSMAN (F. H.). **Biological Studies on** *Bruchidius trifolii* (**Motsch.**) **and** *Bruchidius alfierii* **Pic, in Egypt (Coleoptera: Bruchidae).**—*Bull. Soc. ent. Egypte* **40** pp. 231–277, 37 figs., 58 refs. Cairo, 1956.

The authors record investigations in Egypt confirming that *Bruchidius alfierii* (Pic) is a form of *B. trifolii* (Motsch.) [*cf. R.A.E.*, A **44** 299] and describe observations on the bionomics of these Bruchids, which infest the seeds of Egyptian clover (*Trifolium alexandrinum*). The following is based on their summary of the work. Adults of the typical *B. trifolii*, which have black legs and antennae, are found throughout the year, hibernating under fallen leaves or other shelter in the field and becoming active in spring and early summer, when the new crop is infested. Those of the next generation aestivate in small numbers in stored seeds, appear in numbers at the beginning of October and overwinter. Attempts to breed this form in the laboratory were unsuccessful, as the females did not reach sexual maturity. The other form, which has reddish legs and antennae, has 4–5 generations a year, the adults being abundant in the field in May and June and in storehouses from June to September. Breeding of this form resulted in progeny of both forms and also in intermediates that resembled their parents in type of sexual development and other life processes and paired with others of the intermediate or reddish forms. A female of this form produced males and females of the same form after pairing with a male of the other.

Laboratory observations on the reddish form showed that at 32°C. [89·6°F.] and 50 per cent. relative humidity, the egg stage lasted 5·1 days and the combined larval and pupal stages 15·5 days, adult males and females lived for 8·7 and 3·7 days, respectively, the preoviposition period was 3–4 hours, and the average total number of eggs per fertilised female was about 52. Adults that did not pair lived longer than those that did, but the eggs laid by unfertilised females did not hatch. Length of life and fecundity were both increased when food, such as honey or sugar solution, was provided for the beetles. The eggs were deposited on the seeds of *T. alexandrinum*, preferably on sound ones, the presence of which stimulated oviposition. The larvae bored into the seeds immediately after hatching, passed through four instars and pupated inside the seeds. Temperature and humidity had little or no effect on the preoviposition period or number of eggs, but the egg and larval stages and adult life were all longer at lower temperatures. Females were slightly more numerous than males.

HASSAN (A. S.) & ZAHER (M. A.). **Biology of the Red Spider Mite,** *Eotetranychus cucurbitacearum* **Sayed (Acarina: Tetranychidae).**—*Bull. Soc. ent. Egypte* **40** pp. 301–320, 8 figs., 20 refs. Cairo, 1956.

Tetranychus telarius (L.) (*Eotetranychus cucurbitacearum* Sayed) is a serious pest of many economic plants in Egypt [*cf. R.A.E.*, A **36** 411], and its life-history was studied on potted plants of bean (*Phaseolus vulgaris*) under natural climatic conditions there in 1951–52. It was found that 27 generations developed in the year, fertilised females producing about 18·7–25·4 per cent. male progeny and unfertilised ones males only. Females and males from unfertilised females passed through two nymphal stages, whereas males from fertilised females passed through either one or two [*cf.* **44** 417]. The duration of development was dependent on temperature, and the time required for the completion of a generation ranged from 8·5 days in summer to 43·3 days in winter. Eggs exposed to direct sunlight in summer took a day longer to hatch than those in the shade. The average number of eggs laid per female varied from 79·2 to 151·4, being greatest in autumn. The immature stages of the mite are described, and it is stated that *Scolothrips longicornis* Priesn. and *Orius laevigatus* (Fieb.) afford important control of it.

ABUL-NASR (S.). **Polyhedrosis-virus Disease on Cotton Leaf-worm,** *Prodenia litura* **F.**—*Bull. Soc. ent. Egypte* **40** pp. 321–332, 6 figs., 11 refs. Cairo, 1956.

Larvae of *Prodenia litura* (F.) in Egypt are attacked by a polyhedral virus disease that sometimes causes high field mortality. Laboratory tests, in which larvae were infected by feeding them on leaves of berseem [*Trifolium alexandrinum*] dipped in suspensions of the polyhedra, and kept at temperatures ranging from 13–16°C. [55·4–60·8°F.] in winter to 28–32°C. [82·4–89·6°F.] in summer, showed that the disease developed rapidly in summer and slowly in winter, larvae usually dying 4–5 days after feeding in summer and showing full symptoms only after 10–12 days, if at all, in winter. High relative humidity increased the virulence of the disease and reduced the incubation period. Suspensions of 5–10 million polyhedra per ml. were sufficient to infect larvae in the third or later instars, but concentrations of 50–100 million per ml. were necessary to infect those in the first instar and 25–50 million for those in the second. Field-collected larvae that were reared singly under sterilised conditions in the laboratory showed that natural infection reached 5 per cent. on berseem in spring, 10–20 per cent. on cotton in summer and over 25 per cent. on maize in late summer, when the high temperature and humidity and the heavy larval populations favoured the disease. The symptoms of the disease and its effects on the internal tissues of the larvae are described.

EZZAT (Y. M.). **Studies on the "Kew Bug",** *Orthezia insignis* **Browne (Coccoidea-Ortheziidae).**—*Bull. Soc. ent. Egypte* **40** pp. 415–431, 15 graphs, 1 map, 23 refs. Cairo, 1956.

Orthezia insignis Browne, which has been found on hedges of *Clerodendron inerme*, *Lantana camara*, *Bignonia* and *Ipomoea palmata* in Alexandria, is considered to be a potential pest of many important crops in Egypt, particularly in the north of the Nile Delta, and investigations on its bionomics and control were therefore carried out. All stages are present throughout the year, and laboratory observations of insects kept on sprouting potato tubers indicated that the limiting temperatures were about 14°C. [57·2°F.] (for the adult females) and 34°C. [93·2°F.] (for the eggs). The effects of temperature on the duration of the egg stage, the three nymphal instars, the complete nymphal stage, the preoviposition and oviposition periods and the number of eggs laid are shown on graphs. There was about 10 per cent. mortality in the egg stage and 40 per cent. in the nymphal stage, and most eggs were laid when the temperature was 17°C. [62·6°F.]. There appeared to be about three generations a year, but they overlap because of the long oviposition period, which varied from some 20 days at about 30°C. [86°F.] to 120 days at 17°C.

In tests on control, proprietary mineral-oil emulsions gave about 90 per cent. or more kill, and a 5 per cent. parathion dust about 40 per cent. Two applications of 4 per cent. mineral oil at an interval of five weeks are recommended. Fumigation for 20–90 minutes with hydrogen cyanide generated from 10 g. sodium cyanide, 20 cc. sulphuric acid and 30 cc. water gave complete mortality of all stages, including eggs, in a fumigation chamber with a capacity of 40 cu. ft., and this treatment is recommended for use in greenhouses.

ATTIAH (H. H.). **The Genus *Brevipalpus* in Egypt (Acarina: Tenuipalpidae).**—*Bull. Soc. ent. Egypte* **40** pp. 433–448, 45 figs., 13 refs. Cairo, 1956.

The author gives keys to the adult females and the nymphs of the Egyptian species of *Brevipalpus* and describes the male, female and nymph of *B. lanceolatisetae*, sp. n., from prune, apricot, pear and apple in Lower and Upper Egypt. He also redescribes the male, female and nymph of *B. geisenheyneri* (Rübs.) (*pyri* Sayed) [*cf. R.A.E.*, A **36** 412], and the female and nymph of *B. inornatus* (Banks), which attacks pear, quince, some ornamental plants and weeds, and *B. phoenicis* (Geijskes), which infests pear, quince, vines and ornamental plants, and gives descriptive notes on various stages of *B. australis* (Tucker), which was formerly misidentified as *Tenuipalpus obovatus* Donn. [*cf.* **31** 441] and infests *Citrus*, guava, plum, apricot, vines and ornamental plants, *B. olearius* Sayed on olive and *B. lewisi* McG. on vines. No males of *B. inornatus*, *B. phoenicis* or *B. lewisi* have been observed in Egypt.

FAHMY (I.). **The economic Importance of Mites affecting Fruit Trees, with special Reference to *Citrus*, in Egypt (Acarina).**—*Bull. Soc. ent. Egypte* **40** pp. 449–450, 6 refs. Cairo, 1956.

Severe damage is caused by mites to fruit trees, especially *Citrus*, in Egypt. *Metatetranychus ulmi* (Koch) (*Paratetranychus pilosus* (C. & F.)) has recently been observed on pear in Gharbieh Province, and *Aceria mangiferae* Sayed is very injurious to mango. Damage resembling that caused by *Aceria sheldoni* (Ewing) has recently been noticed on sweet lime and lemon.

HASSANEIN (M. H.). **Nocturnal Activity of Insects as indicated by Light-traps.**—*Bull. Soc. ent. Egypte* **40** pp. 463–479, 2 figs., 37 refs. Cairo, 1956.

The following is taken largely from the author's summary. Investigations on the nocturnal activity, abundance and population density of insects in the field at Shebin El-Kom (Menoufieh), Egypt, were made by means of two light-traps operated almost every night in 1952 and with four in 1953, the source of light being a 200-watt lamp. The average catch was highest in July and lowest in January. Diptera and Homoptera comprised about 78·5 and 14·9 per cent., respectively, of the total catch, and Lepidoptera and Coleoptera about 2·8 and 2·2 per cent. Special attention was devoted to Lepidoptera of economic importance. *Prodenia litura* (F.), the main pest of cotton and clover [*Trifolium alexandrinum*] in Egypt, was taken in all months and was most abundant in June and July. There appeared to be five overlapping generations a year, and females comprised 47·25 per cent. of the total. *Laphygma exigua* (Hb.) was taken from March to December; it had six generations a year, and males and females occurred in almost equal numbers. Four generations of *Agrotis ypsilon* (Hfn.) developed between late September and mid-July, and its absence in August confirmed earlier findings of its migratory habit; numbers were greatest in April, and 52·5 per cent. of the adults were females. *A. spinifera* (Hb.) was present throughout the year and was caught in large numbers from spring to autumn, 45·9 per cent. of the catch being females, and *Earias insulana* (Boisd.) reached a peak of activity in September and October, males being three times as numerous as females. Several species appeared to have two generations a year. Of these, *Autographa* (*Phytometra*) *gamma* (L.) was unusually abundant in March and April, and records of mass flights at this time indicate that it is migratory in Egypt; females and males were about equal in numbers in this species and in *Heliothis armigera* (Hb.) (*Chloridea obsoleta*, auct.). The ratio of males to females was 3:2 for *Chilo suppressalis* (Wlk.) (*simplex* (Btlr.)), which was most active in October, and *A.* (*Syngrapha*) *circumflexa* (L.), and 4:1 for *Pyrausta nubilalis* (Hb.), which was abundant during September and October.

DESCAMPS (M.). **Contribution à l'étude des diptères Diopsidae nuisibles au riz dans le Nord-Cameroun.**—*J. Agric. trop. Bot. appl.* **4** no. 1–2 pp. 83–93, 4 figs. Paris, 1957.

The cultivation of rice is increasing in the North Cameroons, particularly in the Logone valley, but the yield is severely reduced by insect pests. The stems are mined by Lepidoptera, including *Proceras africanus* (Auriv.), and by Diptera, including *Pachydiplosis oryzae* (Wood-Mason) and various Diopsids. Investigations were carried out on the habits of 15 species of this last group, of which seven, *Diopsis thoracica* Westw., *D. collaris* Westw., *D. ichneumonea* L., *D. servillei* Macq., *D. tenuipes* Westw., *D. circularis* Macq., and *D. curva* Bertolini, are injurious to rice and other cultivated graminaceous plants. Of these, the first five occur in rice-fields in low-lying or flood areas, and the last two in the savannah. The females lay 30–60 eggs each, generally singly and on the subterminal leaves of healthy plants, but the eggs of *D. tenuipes* are laid in small groups indifferently on healthy plants and those already infested. The egg, larval and pupal stages last 1–3, 6–33 and 6–12 days, respectively, according to species. Larvae of *D. thoracica* feed only on healthy plant tissues, and those of *D. collaris*, *D. servillei*, *D. circularis*, *D. curva*, and *D. ichneumonea* on healthy tissues during the first few days and then on decomposing material, whereas those of *D. tenuipes* and *D. fumipennis* Westw. feed mainly on decomposing tissues but occasionally attack healthy ones and are even predacious on other insects. Other species of the family are entirely saprophagous. The number of generations a year ranges from two for *D. thoracica*, which remains in diapause for seven months, to eight for *D. servillei*. *D. thoracica* is the principal pest of rice. The larvae enter the stems close to the ligules, bore downwards for several inches and cause yellowing of the terminal leaves. When decomposition sets in, they migrate to other plants, and in this way the larvae destroyed an average of three stalks each in rearing experiments. Pupation occurs in the leaf-sheaths of still other plants. The other species complete their development in a single plant, not more than one larva occurring per stem. General descriptions are given of the eggs, larvae, and pupae of *Diopsis* spp. together with a list of wild grasses attacked by them. Some control is afforded by predators, and considerably more by insect parasites [*cf.* next abstract], lists of which are given.

RISBEC (J.). **Les parasites des insectes borers du riz au Cameroun.**—*Agron. trop.* **11** no. 2 pp. 234–247, 3 figs. Nogent-sur-Marne, 1956. (With Summaries in English and Spanish.)

A list is given of the parasites and hyperparasites reared by Descamps in 1955 from Diptera or Lepidoptera boring in the stems of rice in the French Cameroons [*cf.* preceding abstract]. The new species described, from adults of both sexes unless otherwise stated, comprise *Bruchobius yagouae* and *B. garouae*, from larvae of *Adelpherupa* sp.; *Diourbelia diopsisi*, from pupae of *Diopsis servillei* Macq.; *Anisopteromalus* (*Aplastomorpha*) *camerunus*, from larvae of *Pachydiplosis oryzae* (Wood-Mason); and *Aprostocetus* (*Tetrastichus*) *pachylophusae* (female only) and *T.* (*Epomphaloides*) *dipterae*, from pupae of a species of *Pachylophus* near *P. lugens* Lw. The other primary parasites reared include the Chalcids, *Dirhinus garouae* Risbec, from pupae of *Diopsis collaris* Westw., and *Hyperchalcidia soudanensis* Steffan, from *Proceras africanus* (Auriv.); the Eulophids, *T. pachydiplosisae* Risbec, *T. sesamiae* Risbec and *A.* (*T.*) *brevistylus* Masi, from pupae of *Pachydiplosis oryzae*, *D. servillei* and *D. thoracica* Westw., respectively, and *A.* (*T.*) *diopsisi* Risbec, from *D. servillei*, *D. collaris*, and *D. ichneumonea* L.; the Eurytomids, *Eurytoma diopsisi* Risbec, from pupae of *D. collaris*, and *E. lepidopterae* Risbec, from larvae of *Saluria* sp. and *Adelpherupa* sp.; the Eupelmid, *Eupelmella pedatoria* Ferrière, from a pupa of *D. thoracica*; *Trichogramma* (*Xanthoatomus*) *ethiopicus* (Risbec), from eggs of *Diacrisia scortilla* (Wllgr.), *Diopsis*, *Lema* sp. and undetermined Lepidoptera; the Diapriids, *Psilus* (*Galesus*) *silvestrii* (Kieff.) and *Trichopria oriphila* Kieff., from pupae of *D. collaris* and *D. tenuipes* Westw.; *Platygaster diplosisae* Risbec, from larvae of *Pachydiplosis oryzae*; and the Braconids, *Apanteles ruficrus* (Hal.), from *Proceras africanus*, *Bracon quadratinotatus* var. *sesamiae* Risbec, from *Sesamia* sp., *B. antennatus* Granger, from larvae of *Diopsis curva* Bertoloni and *Opius annulicornis* Granger, from pupae of *D. tenuipes*, and *Diopsis* sp. Notes on the morphology of some of these are given. The hyperparasites include *Melittobia diopsisephila* Risbec, found parasitising *Mepachymerus* (*Steleocerus*) *baculus* Speiser (*lepidopus* (Becker)), which is a parasite of *D. thoracica*, and a new variety of *Neanastatus tenuis* Ferrière, described as var. *platygasteri*, n., from a single female reared from *Platygaster diplosisae*.

FERNANDO (H. E.) & MANICKAVASAGAR (P.). **Economic Damage and Control of the Cacao Capsid,** *Helopeltis* **sp. (fam. Capsidae, ord. Hemiptera) in Ceylon.**—*Trop. Agriculturist* **112** no. 1 pp. 25–36, 4 figs., 13 refs. Peradeniya, 1956.

Cacao in Ceylon is attacked by a species of *Helopeltis* [recently described as *H. ceylonensis* De Silva (*R.A.E.*, A **45** 417)]. It feeds mainly on the pods, but also on young stems and shoots or leaves, and circular areas of "water-soaked" necrotic tissue appear round the feeding sites. Loss of growth and of crop results. Satisfactory control was afforded by sprays of DDT applied by knapsack sprayers equipped with lances and DDT or dieldrin applied by a mist blower, but the operation was time-consuming and reinfestation occurred after about a month. Dusts were therefore tested. They were applied in August 1955, at the peak of attack, at about 10 lb. per acre by means of a power duster, and population counts were made before and 24 hours afterwards. These showed that the mortality percentages were 71·66 for 2·5 per cent. aldrin, 86·56 for 5 per cent. DDT, 89·06 for 0·65 per cent. γ BHC, 99·53 for 1 per cent. dieldrin, and 100 for 1·5 per cent. endrin or 1·3 per cent. γ BHC. Except on the trees dusted with aldrin, reinfestation did not occur for 2–2·5 months, and the period of protection would probably be longer if larger areas were treated. The attack on untreated trees continued undiminished.

GRYLLS (N. E.) & BUTLER (F. C.). **An Aphid transmitted Virus affecting Subterranean Clover.**—*J. Aust. Inst. agric. Sci.* **22** no. 1 pp. 73–74, 4 refs. Sydney, 1956.

A virus disease that affected subterranean clover [*Trifolium subterraneum*] in autumn and early winter and was widespread in New South Wales and, apparently, also occurred in Tasmania, Victoria and Queensland was reported in June 1955. The symptoms, which were variable, comprised stunting of the plants and marginal chlorosis and puckering of the leaflets and resembled those due to mineral deficiency and little-leaf disease [see next abstract] in its early stages. In preliminary glasshouse tests on transmission, none occurred through the seed or as a result of mechanical inoculation, and *Austroagallia torrida* Evans, *Orosius argentatus* (Evans) and *Eurinoscopus punctatus* Evans all failed to transmit the virus, though the last caused marginal yellowing and cupping of the leaflets, but when apterae of *Aphis craccivora* Koch from a colony established on an infected plant were starved for about four hours and then allowed to feed in pairs on healthy seedlings for about an hour, 20 per cent. of the latter became infected, the symptoms developing in 12–21 days. *Myzus persicae* (Sulz.) also transmitted the virus, though less efficiently.

HUTTON (E. M.) & GRYLLS (N. E.). **Legume "Little Leaf", a Virus Disease of subtropical Pasture Species.**—*Aust. J. agric. Res.* **7** no. 2 pp. 85–97, 1 pl., 12 refs. Melbourne, 1956.

Some 40 per cent. of a comprehensive range of species and strains of leguminous pasture plants from different parts of the world grown in experimental plots near Brisbane became infected to varying degrees with a virus disease designated little leaf. This disease also occurs elsewhere in Queensland, and a plot of *Desmodium uncinatum* isolated in a forest reserve became infected with it in 1954 within four months of seeding. The symptoms comprise chlorosis and puckering of the leaves, the production of green distorted buds on plants in flower and of small, rounded, light green leaves from the terminal buds of infected shoots, and a proliferation of spindly, axillary shoots, and they resemble those caused by the virus complex that includes big-bud of tomato, witches' broom of lucerne and potato purple top [*cf. R.A.E.*, A **41** 404; **43** 77], of which it is probably another strain. Infected annual plants died prematurely, and perennials in two or more seasons. In laboratory tests, the virus was transmitted by adults of *Orosius argentatus* (Evans) collected from the plots and by their reinfected progeny, but not by a strain reared in the laboratory at Canberra, although the latter effected some transmission of other viruses of the complex. Most of the species and strains of *Crotalaria*, *Desmodium*, *Indigofera* and *Stylosanthes* were susceptible to the disease, but lucerne, clovers and many plants of potential value in pastures were resistant to it.

WALKER (A. J. K.). **Malathion has important Advantages in the Control of Lucerne Flea and Red-legged Earth Mite.**—*J. Dep. Agric. S. Aust.* **59** no. 10 pp. 386–388. Adelaide, 1956.

Since experiments in Western Australia showed that malathion is as effective as parathion against the lucerne flea [*Sminthurus viridis* (L.)] on pastures and, unlike parathion, also affords some control of the red-legged earth mite [*Halotydeus destructor* (Tucker)] [*cf. R.A.E.*, A **43** 411], recommendations are made for the use of this material in sprays on pastures in South Australia. Treatment affording 1 fl. oz. 50 per cent. malathion emulsion concentrate per acre is effective against *S. viridis* alone, but where *H. destructor* is also present, the addition of 4 fl.oz. per acre of a 25 per cent. DDT concentrate is necessary.

SMITH (W. A.) & SAUNDERS (G. W.). **Tomato Mite Control.**—*Qd J. agric. Sci.* **13** no. 1 pp. 63–65, 9 refs; also as *Bull. Div. Pl. Ind. Dep. Agric. Qd* no. 90, 3 pp., 9 refs. Brisbane, 1956.

Vasates lycopersici (Massee) is common on tomato in Queensland and also feeds on potato, Cape gooseberry (*Physalis peruviana*), *P. minima* and *Solanum nigrum* there; a major pest of tobacco in an area of south-eastern Queensland was determined in 1955 as an unidentified but closely related species. In field tests on control begun on 18th September 1951, tomato plants were sprayed weekly or fortnightly with 0·02 per cent. parathion to give 1·6–4·8 oz. toxicant per acre, according to plant size, or fortnightly with 0·01 per cent. parathion to give 0·8–2·4 oz. or with sulphur at 3·75–12·25 lb. per acre; some were treated in alternate weeks with the sulphur spray and a dust affording 5–15 lb. sulphur per acre, and all plants also received fortnightly sprays of 0·1 per cent. DDT and 0·25 per cent. copper oxychloride. On 13th November, the mite population per plant was assessed by a sampling technique that is described, and it was found that all the treatments caused significant reductions; parathion was significantly superior to sulphur in the spray, but not to the combined treatment. In further trials in 1954, treatments were applied from 14th July until a week before the final harvest, in October, and the method of counting the mites was improved. Highly significant reductions in population were given by weekly or fortnightly sprays of 0·015 per cent. parathion, fortnightly sprays of lime-sulphur (0·22 per cent. polysulphides) or treatment in alternate weeks with 0·15 per cent. wettable sulphur and sulphur dust, but infestation was late in developing and none of the treatments increased the yield. In comparison with parathion, Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite), Ovotran (p-chlorophenyl p-chlorobenzenesulphonate), Chlorparacide (p-chlorobenzyl p-chlorophenyl sulphide), Elimite (p-chlorophenyl benzenesulphonate) and Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] were of no value. In view of local field conditions, sulphur was recommended for use on tomatos and parathion for tobacco.

FORTE (P. N.) & GREAVES (T.). **The Effectiveness of Dieldrin for the Control of the Argentine Ant in Western Australia.**—*J. Dep. Agric. W. Aust.* (3) **5** no. 1 pp. 85–88, 91–92, 95–96, 6 figs., 1 ref. Perth, W.A., 1956.

Further observations were made in November 1953 round blocks of houses near Perth, Western Australia, where sprays of 2 per cent. chlordane, aldrin and dieldrin had been applied in late 1951 for the control of *Iridomyrmex humilis* (Mayr) [*cf. R.A.E.*, A **42** 347]; buffer sprays of 2 per cent. chlordane to prevent reinfestation or migration between plots had last been applied in February 1952. It was found that neither chlordane nor aldrin had completely eradicated *I. humilis* or native ants. There were nests of native ants, but not of *I. humilis*, in the plot treated with dieldrin, and examples of *I. humilis* seen on the day of examination were all dead the following morning. In May 1955, dieldrin was still preventing establishment of *I. humilis* and killing examples entering the treated area.

In a further test, sprays of dieldrin and aldrin at 0·5 and 1 per cent. and chlordane and DDT at 2 per cent. were applied in March 1953 round blocks of houses at rates varying from 42 to 52 gals. per acre according to the amount of vegetation present. Buffer areas were sprayed with 2 per cent. chlordane. Aldrin at both concentrations caused marked reductions in numbers within a week, but there was an increase 46 weeks later. Dieldrin at 1 per cent. eradicated *I. humilis* within nine weeks and ants that established a trail 46 weeks after treatment died within two days. Chlordane and 0·5 per cent. dieldrin eradicated the ants in 29 weeks, but did not prevent reinfestation, though, in the case of dieldrin, this occurred only where the ground had been considerably disturbed after treatment. DDT was not effective.

The minimum concentration of dieldrin necessary for eradication was investigated in 1954. The four concentrations tested ranged from 0·125 to 0·5 per cent., and applications were made between 26th January and 3rd February at 60–70 gals. per acre. Concentrations of 0·5 and 0·375 per cent. resulted in complete eradication in about 39 weeks, 0·25 per cent. gave excellent control for 62 weeks, when the last examination was made, and 0·125 per cent. caused a reduction for 39 weeks. It is concluded that, since successful eradication depends on the skill of the operator as well as on the insecticide, a concentration of 0·5 per cent. should be used.

JENKINS (C. F. H.). **Codling Moth in Western Australia.**—*J. Dep. Agric. W. Aust.* (3) **5** no. 6 pp. 693–696, 5 figs. (4 col.), 2 refs. Perth, W.A., 1956.

Cydia pomonella (L.), the bionomics and control of which are reviewed, was found infesting apple at Bridgetown, Western Australia, in March 1956. Between 1903 and 1951, 16 outbreaks of the moth occurred at various places in this State [*cf. R.A.E.*, A **36** 106], but it was eradicated on each occasion.

CLARK (P. J.) & JACKS (H.). **The Schradan Content of Fruit and Vegetables.** —*N.Z. J. Sci. Tech.* **38** (B) no. 1 pp. 58–65, 6 refs. Wellington, N.Z., 1956.

The schradan content of crops treated with this insecticide was investigated in New Zealand; the schradan was usually applied in sprays, but it was also watered on soil in which swedes were growing and used as a dip in which seed potato tubers were soaked. Schradan was detected in the swedes and in all the sprayed crops, which comprised swedes, potatoes, peas, beans, cabbages, carrots, strawberries and apples, the amount present increasing as the interval between the final treatment and harvest became shorter. In potatoes, the schradan was unequally distributed between individual tubers on the same root, and storage after harvesting did not reduce the amount present in them or in swedes; it was detected in tubers produced by plants grown from the soaked tubers. In the absence of an approved tolerance and in view of the amounts found, it is considered inadvisable to apply schradan to edible crops.

JACKS (H.). **A Note on Control of Clover Mite** (*Bracobia practiosa* **Koch**) **on** *Dianthus chinensis* **L.**—*N.Z. J. Sci. Tech.* **37** (A) no. 6 pp. 523–525, 1 ref. Wellington, N.Z., 1956.

The results are given of glasshouse tests with sprays of 12 acaricides, mostly in proprietary form, for the control of *Bryobia practiosa* Koch, the methods used being similar to those in investigations with another mite [*R.A.E.*, A **44** 335]. Of the contact poisons, those that gave satisfactory immediate control, with their effective percentage concentrations, were Aramite (15 per cent. 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) (0·05), Murphy Tepp (40 per cent. tetraethyl pyrophosphate) (0·05), malathion (0·25), and Murphos 20 (20 per cent. parathion) (0·05). Materials that were less effective immediately but showed effective residual action were Chlorocide (20 per cent. p-chlorobenzyl p-chlorophenyl sulphide) (0·25), Murvesco (50 per cent. p-chlorophenyl benzenesulphonate) (0·1), and Ovamite (50 per cent. p-chlorophenyl p-chlorobenzenesulphonate) (0·05), which was inferior to Chlorocide. Both immediate and residual action were shown by summer oil emulsion (1·5), Systox (50 per cent. demeton [diethyl 2-(ethylthio)ethyl phosphorothioate]) (0·05) and Hanane (50 per cent. dimefox [bis(dimethylamino) fluorophosphine oxide]) (0·05). Shell Supona DPS (35 per cent. diphenyl sulphone) and Tetrax (70 per cent. schradan) significantly reduced the population, but were inferior to the other materials.

RIVERA (C. T.). **Three organic Insecticides in the Control of Insects affecting upland Rice.**—*Philipp. Agric.* **39** no. 8 pp. 465–472, 1 ref. College, Laguna, 1956.

CALORA (F. B.). **Three Insecticides in the Control of Insects affecting lowland Rice.**—*T. c.* no. 9 pp. 520–527, 7 refs.

In these two papers, the results are given of experiments with emulsion concentrates of parathion, TEPP [tetraethyl pyrophosphate] and toxaphene for the control of *Schoenobius incertulas* (Wlk.), *Cnaphalocrocis medinalis* (Gn.) and *Leptocorisa acuta* (Thnb.) on rice in the Philippines.

The tests described in the first paper were carried out on upland rice from April 1954 to January 1955. Sprays of 9·5 cc. 20 per cent. TEPP, 4 cc. 46·7 per cent. parathion and 3·2 cc. 60 per cent. toxaphene per U.S. gal. water, applied at about 120 U.S. gals. per acre six times at intervals of a week from 7th August, when the plants were two months old, reduced the mean percentage of leaves damaged by *C. medinalis* from 21·2 to 7·4, 7·2 and 12·5, respectively, and the same sprays applied three times at intervals of two weeks reduced it to 14·3, 13 and 15·3. The corresponding percentages of stems damaged by *S. incertulas* were 26 on untreated plants, and 5·3, 2·9 and 14·6 for six applications and 11·6, 10·2 and 17 for three on treated ones, and the percentages of panicles free from damage by *L. acuta* were 32 for no treatment, 67·1, 63 and 48·7 for six applications and 51·1, 46·7 and 42 for three. All treatments gave significant control, without damaging the plants, and six applications of TEPP and parathion, but not of toxaphene, were better than three against each insect. In comparison with no treatment, yields were 12·06, 12·94 and 2·8 per cent. greater after six applications and 5·26, 0·39 and 0·07 per cent. greater after three. In laboratory tests in which adults of *L. acuta* and larvae of *C. medinalis* were caged on sprayed plants and larvae of *S. incertulas* placed on tillers 24 hours before the plants were sprayed, TEPP, parathion and toxaphene at the same concentrations as before gave complete mortality of *L. acuta* in 12, 24 and 96 hours, respectively, of *C. medinalis* in 48, 24 and 96 hours, and of *S. incertulas* in 48, 72 and 120 hours, whereas no insects died on untreated rice. All insects fed on the treated plants.

The tests described in the second paper were made on lowland rice between December 1953 and January 1955. In the field, the sprays were applied at the same concentrations and intervals from 60 days after transplanting, the plots being drained before spraying and flooded to a depth of 2–4 ins. after it. Six applications of TEPP, parathion and toxaphene reduced the percentage of leaves damaged by *C. medinalis* from 14 to 4·2, 3·3 and 4·7, respectively; three reduced it to 7, 6·8 and 7·5, and all reductions were significant. The corresponding reductions in the percentage of stems damaged by *S. incertulas* were from 19·3 to 7·3, 1·4 and 1 for six applications and 12·3, 7·7 and 2·5 for three, all reductions but that following three applications of TEPP being significant. Only parathion gave significantly better results against either insect when applied six times. All treatments were followed by reductions in the percentage of panicles injured by *L. acuta* and increases in yield, but none of the differences was significant. There was no insecticide damage to the plants at the time of application, but the leaves of treated plants yellowed more rapidly than those of untreated ones when the rice was in the late dough stage. In the laboratory, parathion gave complete mortality of nymphs and adults of *L. acuta* in 72 and 48 hours, respectively, whereas TEPP and toxaphene killed 12 and 19, respectively, of 30 nymphs in 72 hours and 28 of 30 adults in 168 hours; surviving nymphs transformed to adults in 96 hours. All three insecticides repelled both the nymphs and adults. Complete mortality of *C. medinalis* was obtained in 72, 168 and 96 hours, respectively, and of *S. incertulas* in 48, 144 and 144 hours. All insects fed to some extent on the treated plants, and the adults of *L. acuta* oviposited. There was no mortality on untreated rice until 168 hours after the beginning of the experiment, when some examples of *L. acuta* died of starvation.

Reyes (G. M.). **Rice Dwarf Disease in the Philippines.**—*FAO Plant Prot. Bull.* **6** no. 2 pp. 17–19, 2 figs., 4 refs. Rome, 1957.

The virus disease known as rice dwarf or rice stunt was first observed in the Philippines during the Japanese occupation in 1943–44 on upland rice grown in Manila. It disappeared with the destruction of most of the city in 1945, but reappeared in 1956 on seedling rice of varieties imported from the United States. The vector, *Nephotettix apicalis* var. *cincticeps* (Uhl.), is present in the Philippines, and in tests in which this Cicadellid was used to transmit the virus from the infected plants to nine local varieties of rice, all became infected to varying degrees. The stunting reported earlier [*R.A.E.*, A **30** 383] is considered not to be caused by the same virus, on account of the difference in symptoms.

Fukushi (T.) & others. **Studies on the Insect Transmission of Potato Witches' Broom.** [*In Japanese.*]—*Mem. Fac. Agric. Hokkaido Univ.* **2** no. 3 pp. 52–61, 1 pl., 31 refs. Sapporo, 1955. (With a Summary in English.)

The witches' broom virus disease has occurred sporadically on potato in Hokkaido since 1932. In 1953, a similar disease was observed on red clover and alsike clover [*Trifolium repens* and *T. hybridum*] in a field near infected potatoes. *Ophiola flavopicta* (Ishihara) was abundant on the clover, and this Cicadellid was tested for ability to transmit the viruses from clover and potato to potato seedlings. It transmitted the potato virus to 6 out of 23 seedlings and the virus from red clover to 3 out of 10, all infected seedlings showing symptoms typical of potato witches' broom. As *Vicia unijuga* growing near infected potato was also infected with a witches' broom disease, it was included in further tests. In these, *O. flavopicta* transmitted the virus from infected potato, clovers, and *V. unijuga* to healthy plants of these species, and it therefore appears that one virus is the cause of all these infections. The virus probably hibernates in the roots of clover or *V. unijuga*, and is probably disseminated to potato by infected Cicadellids.

AUSLAND (O.). **Gulrotflua** (*Psila rosae* **Fabr.). Undersøkelser over dens biologi i Norge.** [The Carrot Fly (*P. rosae*). Investigations on its Biology in Norway.]—*Meld. Plantev.* no. 14, 68 pp., 30 figs., 47 refs. Oslo, 1957. (With a Summary in English.)

Psila rosae (F.) is a serious pest of carrots in Norway, where it occurs up to about 68° 50′N. lat. Investigations in the south in 1953–54 showed that losses varied considerably, but sometimes involved the whole of a crop, and damage was commonly as high as 30–40 per cent. All stages of the fly are described, and an account is given of observations on its bionomics. It has two generations a year as far north as 63° 28′N. lat., but the second is of importance only in favourable districts. Other umbelliferous crops are also attacked. Adults were found sheltering on various plants outside carrot fields, notably on red currant. Those of the overwintered generation survived for an average of 3·9 days in screen cages, and all were dead in nine days. The adults observed in carrot fields were almost all gravid females, and they were commonest in the late afternoon.

The emergence of the adults of the overwintered generation was spread over 55 days, beginning in late May or early June in the south and a month or more later in the north, and that of the first generation began at the end of August or in early September. Individual females contained 38–98 eggs each. The egg stage averaged 16 days at an average temperature of 12·5°C. [54·5°F.] and 11–12 days at 14·5°C. [58·1°F.], and counts of the larvae showed that 68 per cent. were in the roots and the remainder in the soil. Infestation was heaviest at the edges of a field. The larval stage lasted about a month for the first generation, and rather longer for the second, owing to the lower temperature, and pupation occurred mostly in the upper 4 ins. of soil.

Some individuals of both generations overwintered, and all pupae formed after mid-August did so. Mortality among the overwintering population ranged up to 70 per cent. Parasites that emerged from field-collected pupae comprised *Dacnusa gracilis* (Nees) and *Loxotropa tritoma* (Thoms.), and they formed 2–17 per cent. of all the adults emerging.

PAPERS NOTICED BY TITLE ONLY.

NIRULA (K. K.) & MENON (K. P. V.). **Insect Pests of Coconut Palm in India.**—*FAO Plant Prot. Bull.* **6** no. 1 pp. 1–5, 17 refs. Rome, 1957. [*Cf. R.A.E.*, A **45** 337, etc.]

SYNAVE (H.). **Insects of Micronesia. Vol. 6 no. 4. Homoptera: Cercopidae.**—pp. [3+] 213–230, 7 figs., 1 map. Honolulu, Bishop Mus., 1957. CARVALHO (J. C. M.). **Vol. 7 no. 1. Heteroptera: Miridae.**—pp. [3+] 1–100, 58 figs., 1 map. 1956. ROSS (E. S.). **Vol. 8 no. 1. Embioptera.**—pp. ii+ 1–8, 2 figs., 1 map. 1955. HARDY (D. E.). **Vol. 13 no. 1. Diptera: Dorilaidae (Pipunculidae).**—pp. [3+] 1–9, 6 figs., 1 map. 1956. HARDY (D. E.) & ADACHI (M.). **Vol. 14 no. 1. Diptera: Tephritidae.**—pp. [3+] 1–28, 15 figs., 1 map. 1956. GRESSITT (J. L.). **Vol. 17 no. 1. Coleoptera: Chrysomelidae.**—pp. ii+ 1–60, 19 figs., 1 map. 1955. KULZER (H.). **Vol. 17 no. 3. Coleoptera: Tenebrionidae.**—pp. [3+] 185–256, 11 figs., 1 map. 1957. [*Cf. R.A.E.*, A **43** 345; **45** 332.]

Pospelova-Shtrom (M. V.). **On Food Resources of Ticks—Vectors of Tick-borne Relapsing Fever in inhabited Localities.** [*In Russian.*]—*Zool. Zh.* **35** pt. 4 pp. 529–534, 2 figs., 1 ref. Moscow, 1956. (With a Summary in English, suppl. p. 6.)

To ascertain the hosts of *Ornithodoros* (*Alectorobius*) *tholozani* (Lab. & Mégn.) in inhabited areas, precipitin tests were carried out to identify the blood in the stomach contents of 3,356 fully fed examples of all stages, of which 2,753 were collected in a mountain village in Tadzhikistan and 603 in a foothill village in southern Kirgizia. Positive reactions were obtained with 99·5 per cent. of the ticks and showed that the percentages that had fed on the different kinds of hosts were 80·5 on Bovids (cattle, sheep and goats), 5·4 on horses, 7·6 on dogs and cats, 2·9 on hens and 1 on man, the hosts of the remainder being pigs and rodents. The figures for the two areas showed the same order of host preference, and differences betweeen them could be explained by the effects of local conditions on host availability. Cattle, sheep and goats were the preferred hosts of larvae and nymphs as well as adults, and there was no evidence of any seasonal change in host selection.

Shaldybina (E. S.). **Vertical Migrations of oribatid Mites.** [*In Russian.*]—*Zool. Zh.* **35** pt. 4 pp. 535–545, 3 graphs, 6 refs. Moscow, 1956. (With a Summary in English, suppl. pp. 6–7.)

Details are given of an investigation, carried out near Gorky in 1950, of the factors that affect the migration between grass and soil of the oribatid mites that are intermediate hosts of Anoplocephalid tapeworms of livestock. A knowledge of these factors might enable infested pasture to be used with fair safety at times when the mites had left the grass and so would not be ingested with it. Three plots were selected, in dry and damp meadow-land and in deciduous forest, and samples of soil and grass (or other low-growing plants and litter in the forest plot) were taken five times on one day in each month from May to October and in December. The sampling times were midnight, dawn, 10 a.m., 2 p.m., and soon after sunset. The percentages of the mites found in the different samples on each date are shown in tables and graphs and discussed in relation to the microclimate of the grass as affected by rain, dew and temperature. The greatest depth in the soil at which the mites were found ranged from 0·5 cm. if the grass was very wet to 3 cm. if it was very dry. Their numbers in the grass were smallest in the hottest and driest part of the day and largest at midnight and dawn.

Humidity was shown to be the main factor affecting vertical migration, decreases in relative humidity in the daytime being followed by migration from the grass to below the surface of the soil, but temperature was also of importance. The mites sheltered in the soil in hot sunny weather, even if the air was damp, and all of them left the grass when the temperature fell gradually to 0°C. [32°F.] or lower. If, however, the temperature dropped suddenly after rain, when the soil was wet, the mites could not migrate below the surface and were numerous in the grass even under snow cover. The proportion of mites in the grass was smallest where the soil was loose and contained a considerable amount of decaying matter. Mites were present in the grass of the damp meadow during the whole grazing season, though their numbers showed marked daily fluctuations. In the dry meadow, they were numerous in the grass only in warm and damp weather, or between sunset and dawn. It is recommended that infested pastures should not be used for a period of two years, or used only during the daytime when the weather is dry.

SMIRNOV (E. S.) & CHUVAKHINA (Z. F.). **Visual Distinction of Number, Size and Form in** *Musca domestica* **L.** [*In Russian.*]—*Zool. Zh.* **35** pt. 4 pp. 560–571, 4 graphs, 2 refs. Moscow, 1956. (With a Summary in English, suppl. pp. 9–10.)

Batches of 100 newly emerged adults of *Musca domestica* L. were caged with two watch-glasses, each containing a bait of sugar, after one or more pieces of black paper, cut to form triangles, squares or rectangles, had been placed on one or both of the baits. Flies that visited the baits were disturbed as soon as they did so and allowed to settle again. Observation was continued until the baits had been visited frequently (usually several hundred times), and the difference between the percentages of visits received by the two baits was then taken as the coefficient of attractiveness (K). Small triangles were used in the first series of tests; they had a base 5 mm. long and an area of 20 sq. mm. so that they roughly resembled a fly in outline. They proved attractive, the K figures being 22, 30, 46 and 48 for baits having one, two, three and four triangles compared with one having none, and 16 and 24 for a bait having four compared with baits having two and one, respectively. A bait with four of the small triangles was then tested against one with a single triangle having the same total area (80 sq. mm.), and the two were equal in attractiveness.

In a series of experiments in which triangles of various sizes were tested singly, those with an area of 7·2 sq. mm. or less showed no attractiveness, but the K figures for larger ones increased with their size from 16 for an area of 12·8 mm. to 54 for one of 80 mm. Where the triangles were tested against one another, a considerable difference in size was required for the larger one to be definitely more attractive than the smaller.

The ability of the flies to differentiate shape was investigated by testing a square with an area of 36 sq. mm. against rectangles of the same area. The K figures, all in favour of the square were 4, 14, 12, 24 and 46 when the widths of the rectangles were 4, 3, 2 and 1 mm., respectively.

It is concluded that the reactions observed in these experiments were manifestations of the instinct that causes flies to be more intensively attracted by food if it is already frequented by other flies.

SCHMIDT (C. H.) & DAHM (P. A.). **The Synthesis of C^{14}-labeled Piperonyl Butoxide and its Fate in the Madeira Roach.**—*J. econ. Ent.* **49** no. 6 pp. 729–735, 4 figs., 11 refs. Menasha, Wis., 1956.

The following is almost entirely taken from the authors' summary. As an aid to the study of the mode of action of piperonyl butoxide, one of the important pyrethrum synergists, radioactive piperonyl butoxide, α-(2-(2-n-butoxyethoxy)-ethoxy)-4,5-methylenedioxy-2-propyltoluene-α-^{14}C, was prepared by reacting ^{14}C-labelled paraformaldehyde with dihydrosafrole and then condensing the resulting chloromethyl derivative of dihydrosafrole with the sodium salt of diethylene glycol n-butyl ether. The radioactive piperonyl butoxide was purified by vacuum distillation (over-all yield was 61 per cent. based on ^{14}C-labelled paraformaldehyde) and had a calculated activity of 0·157 μc. per mg. Ultraviolet and infrared spectra were used to establish purity and structure of the compound. Three procedures for locating piperonyl butoxide on paper chromatograms, developed with acetonitrile, methanol and water (2 : 2 : 1) as the solvent system, are described, in addition to a radioactive scanning technique. Two dyes and a sulphuric-acid streaking technique can be used on chromatograms containing over 50 μg. of piperonyl butoxide. For smaller amounts, an ultraviolet scanning method based on absorption of 290 mμ. was useful. The results are also given of an investigation of the effect of organic solvents on two colorimetric tests for piperonyl butoxide.

A study was made of the absorption and excretion of radioactive piperonyl butoxide after its topical application to the ventral thoracic area of males and females of *Leucophaea maderae* (F.). About 88 per cent. was absorbed in three days. About half the radioactivity in the applied dose was recovered from the faeces in seven days. Paper chromatographic analysis of faecal extracts showed that less than half of the radioactivity was from piperonyl butoxide; the remainder consisted of unidentified, water-soluble metabolites. The internal distribution of radioactivity in female cockroaches showed that the brain and thoracic ganglia, fore-gut, and hind-gut and Malpighian tubules contained the greatest amounts of radioactivity per unit weight. Since little radioactivity was found in the other tissues, it is postulated that the nervous tissue, fore-gut, and hind-gut and Malpighian tubules are involved in the breakdown of radioactive piperonyl butoxide in females of *L. maderae*.

Cole (M. M.) & Burden (G. S.). **Phosphorus Compounds as Ovicides and Adulticides against Body Lice.**—*J. econ. Ent.* **49** no. 6 pp. 747–750, 17 refs. Menasha, Wis., 1956.

The minimum concentrations giving complete mortality (MLC) of eggs 0–2 days old and adults of *Pediculus humanus humanus* L. are shown for 73 phosphorus compounds tested as acetone solutions at Orlando, Florida, in 1954–55 against a normally insecticide-susceptible strain. The eggs were exposed by a dipping method [*R.A.E.*, B **45** 8] and the adults on impregnated cloth [**34** 44]. Parathion, with an MLC for eggs of 25 parts per million, was the most effective ovicide, and sulfotepp [tetraethyl dithionopyrophosphate] was the most effective compound against adults, with an MLC of 0·025 p.p.m. Malathion and Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], which hold the most promise for practical use in louse powders because of their low toxicity to mammals, had MLC's of 10 p.p.m. against adults and 0·05 and 0·1 per cent., respectively, against eggs. The mortality of eggs caused by tetraethyl thionopyrophosphate at 0·05 per cent. was increased from 25·3 to 100 per cent. by the addition of 0·5 per cent. sulfoxide [1,2-methylenedioxy-4-(2-(octylsulphinyl)propyl)-benzene], but the toxicity of three other phosphorus compounds was not enhanced.

Adults and eggs from the extremely DDT-resistant Korean strain of the louse [*R.A.E.*, B **44** 18] showed no cross-resistance to ten of the phosphorus compounds, including malathion, Chlorthion, parathion and sulfotepp. A test against eggs of the normal strain, in which malathion was the only insecticide used, showed that its ovicidal effectiveness was directly correlated with relative humidity. At 70 per cent., the maximum likely to be found under clothing, 0·025 per cent. malathion gave 96·2 per cent. kill. The effectiveness of both malathion and Chlorthion increased with the age of the eggs, though that of dinitroanisole decreased, as in previous investigations [**33** 172; **36** 116].

Malathion and Chlorthion were also tested at several concentrations as powders in pyrophyllite. At concentrations of 1, 0·5 and 0·25 per cent., malathion killed 100, 97·6 and 38·6 per cent. of the eggs, and Chlorthion killed 96·7, 65·9 and 21·1 per cent. Both were completely effective against adult lice for 14 days at 0·1 per cent. Phosphorus insecticides are not yet recommended for use against *P. h. humanus*, but toxicological data indicate that some may be as safe to use as DDT.

Keller (J. C.), Wilson (H. G.) & Smith (C. N.). **Bait Stations for the Control of House Flies.**—*J. econ. Ent.* **49** no. 6 pp. 751–752, 6 refs. Menasha, Wis., 1956.

Scattered poison baits for the control of *Musca domestica* L. (whether liquid, dry or granular [*R.A.E.*, B **44** 73–74; **45** 2, etc.]) have the advantages that most flies find and feed on them within a few minutes, they are not dangerous for children or animals if they have been properly applied, and little insecticide and no special apparatus are needed. However, they must be applied every 1–3 days until breeding has been considerably reduced, much of a liquid bait is lost if it is on an absorbent surface, granular and sugar baits are soon lost when used on soil or litter, and all three kinds may be swept or washed away when used on floors in buildings. Experiments were therefore made in 1955 principally in Florida with bait " stations " designed to combine the advantages of scattered baits with a more permanent method of application. A station consisted of a wooden tongue-depressor to which was stapled an absorbent paper disk $3\frac{1}{4}$ ins. in diameter, a piece of screen 4 ins. square or a piece of plastic-impregnated screen 4 × 7 ins. with 3 ins. turned down to form an awning. The baits containing the insecticides were honey, milk chocolate or slurries of sugar alone or with agar, sand or other ingredients, and the insecticide concentrations were 1 per cent. in the slurry of sugar only and 2 per cent. in all the other baits. The paper disks were treated by coating them with the chocolate or soaking them for 24 hours in the honey and the screens were coated with the slurries on one side.

Stations were best placed with the treated part vertical and near the ground. They were stapled to door frames or propped against walls or put on ledges or sills in dairy barns and put on sacks or carts or suspended from light fixtures in the feed rooms. In dairy barns, 5–40 stations treated with Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] reduced fly populations by 85–99 per cent. in one day and generally by more than 85 per cent. for 28–70 days and 15–50 malathion stations reduced them by 95–96 per cent. in one day and by 67–99 per cent. for 42–70 days. In poultry houses containing caged laying hens, stations were used on the ground at the edge of the manure and at right angles to the line of cages, at the rate of one to every 10 ft. The percentage reductions in fly populations were 73–98 after one day and 88–99 for 42–84 days by L 13/59, 82–84 after one day and generally 89–99 for 21–98 days by malathion, and 85 after one day and 93–99 for the ensuing 28 days by Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate] which was tried only once. In single tests, stations prepared with chocolate, honey or sugar alone were less effective than those prepared with 50 per cent. sugar, 46 per cent. sand and 2 per cent. agar. At pig pens, the stations were placed about the garbage rack and cooker, stapled to fence posts or stuck in the soil or manure. Malathion on 50–100 stations gave reductions of 0–99 per cent. after one day, and subsequent control ranged from very poor to excellent for as long as 98 days; L 13/59 on 100 stations gave reductions of 91–99 per cent. for 21–84 days, and Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] on 50 stations was moderately effective in two tests, giving reductions of 73–97 per cent. for 21–28 days. In feed lots, stations treated with L 13/59 were put in rooms or passages, stapled to fence posts or other vertical surfaces or pushed into the ground or manure. They gave 93–98 per cent. control for 21–42 days in two tests, whereas control in the third was poor for the first week but excellent for the next three.

On farms in Kansas and Nebraska, most of the stations were stapled to vertical surfaces such as mangers and doors in animal sheds, barns and milking rooms, and some were occasionally put outside where flies were congregating about unsanitary situations. Malathion and L 13/59 were about equally effective. Control ranged from 16 to 82 per cent. after one day and required 2–5 days to reach 90 per cent. in six tests and 11 days in two others.

Peterson jr. (G. D.). **The Introduction of Mosquitoes of the Genus** *Toxorhynchites* **into American Samoa.**—*J. econ. Ent.* **49** no. 6 pp. 786–789, 2 refs. Menasha, Wis., 1956.

An account is given of the introduction into American Samoa of *Toxorhynchites brevipalpis* Theo. and *T. splendens* (Wied.), in the hope that the larvae, which are predacious, might contribute effectively to the control of *Aëdes polynesiensis* Marks (*pseudoscutellaris*, auct.). Experiments had indicated that *A. polynesiensis* could not be controlled by orthodox methods, as it is a jungle and bush species and breeds in very varied small natural or artificial containers [*cf. R.A.E.*, B **43** 205] and rarely rests in buildings of any kind. *T. brevipalpis* was therefore introduced by D. H. Butchard in 1952, but apparently did not become established. With *T. splendens*, it was introduced again in January 1955 by C. P. Hoyt, who established breeding colonies and maintained them until he left in May. The author resumed laboratory rearing and release of both species on Tutuila when he succeeded Hoyt as staff entomologist in July.

Stock colonies of third- and fourth-instar larvae were obtained from the Bureau of Mosquito Control in Hawaii. The method of rearing used was essentially that of Bonnet & Hu [**41** 77–78] with some modifications. The mosquitos were kept in batches of about 250 in breeding cages measuring 2 × 2 × 2 ft., the top and three sides of which were of white organdie and the back of muslin with a muslin sleeve. Water and the 10 per cent. maize syrup in water were supplied on pads in petri dishes. Bamboo sections were provided for oviposition. For hatching, eggs were put in batches of up to 200 in pans of stagnant water from the field with *Culex* egg rafts to provide food for the *Toxorhynchites* larvae when both groups hatched. The *Toxorhynchites* larvae ate about ten *Culex* larvae per day, and needed food daily in the early instars. They were put into individual containers in tap water when they reached the third instar. Development was accelerated by exposure to constant artificial light. Pupae were strained off and kept on wet cotton pads for emergence, and the adults were kept for five days for mating before release. Many thousands were liberated, and both species have been recovered from the field, so that initial establishment has apparently been obtained.

Robbins (W. E.), Hopkins (T. L.) & Eddy (G. W.). **The Metabolism of P^{32}-labeled Bayer L 13/59 in a Cow.**—*J. econ. Ent.* **49** no. 6 pp. 801–806, 5 figs., 16 refs. Menasha, Wis., 1956.

The following is based on the authors' summary. A study was made of the metabolism and excretion of ^{32}P-labelled Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] by a lactating Hereford cow to which it was administered orally at the rate of 25 mg. per kg. and of its uptake by larvae of *Hypoderma bovis* (Deg.) in cysts in the cow's back. The peak of radioactivity in the blood was attained between the first and third hours after treatment, with a maximum equivalent to 15·1 μg. insecticide per ml. in the two-hour sample. When the sample was analysed chromatographically, only about 7·5 per cent. of the radioactivity or the equivalent of 1·1 μg. per ml. ran with the R_f of L 13/59. Radioactivity appeared to be dissipated more slowly in the exudate in the cysts of *H. bovis* than in the blood. Only low levels of radioactivity were detected in larvae removed at various times after treatment, and the maximum per unit weight was found in those removed after 6–24 hours.

Less than 0·2 per cent. of the radioactivity representing the total dose administered had appeared in the milk secreted up to 144 hours after treatment. When a 6–48 hour composite sample was extracted repeatedly with chloroform, less than 10 per cent. of the radioactivity behaved like unchanged L 13/59. When the chloroform extracts were analysed chromatographically, only trace amounts of radioactivity ran with the same R_f as L 13/59. About 23 per cent. of the radioactivity present in the composite milk behaved like inorganic phosphorus. These findings were supported by bioassay studies with house-flies [*Musca domestica* L.].

L 13/59 was rapidly metabolised by the cow and eliminated in the urine. The peak of elimination was attained after 2½–5½ hours, with a concentration of about 1·4 mg.-equivalents per ml. urine. After 12 hours, about 66 per cent of the dose had been accounted for in the urine. When the urine was analysed chromatographically, it was found that only 0·26 per cent. of the radioactivity excreted during this period was unchanged L 13/59. Chromatography of the urine metabolites disclosed that only 16·8 per cent. of the radioactivity ran with the R_f of dimethyl hydrogen phosphate or dimethyl hydrogen phosphite. About 76 per cent. ran with a mean R_f of 0·23 and represented an unknown metabolite. These data indicate that metabolism of L 13/59 in the cow does not occur mainly through rupture of the P-C bond. No DDVP [dimethyl 2,2-dichlorovinyl phosphate] was detected in the blood, milk or urine. That L 13/59 was readily absorbed by the cow was shown by the small amount of radioactivity in the faeces. Less than 3 per cent. of the dose was accounted for in all faecal samples collected.

HARDING jr. (W. C.) & QUIGLEY (G. D.). **Litter Treatment with Malathion to control the Chicken Body Louse.**—*J. econ. Ent.* **49** no. 6 pp. 806–807, 4 refs. Menasha, Wis., 1956.

The following is based on the authors' summary. Litter treatments with 4 per cent. malathion dust applied at 0·5, 0·25, 0·2 and 0·1 lb. to 20 sq. ft. gave excellent initial control of *Menacanthus stramineus* (Nitzsch) on hens and cocks in Maryland in 1955. With 0·25 or 0·5 lb., control was maintained for at least five weeks. All litter treatments were made by hand and included mixing a small handful of the dust in the nesting material in each nest. The litter (wood shavings) in all treated pens was dry, so that the fowls had ample opportunity to dust themselves. Tests with eggs from pens treated at 0·25 lb. per 20 sq. ft. and with others over which 4 per cent. malathion dust had been rubbed showed that the dust had no effect on the percentage hatch. No malathion was detected by analysis in the yolks or whites of eggs that had been kept for two weeks (or four weeks in a refrigerator) after they had been collected from treated litter or rubbed with the dust, even if the shells were cracked slightly before they were rubbed.

ACREE jr. (F.), BABERS (F. H.) & MITLIN (N.). **Preparation of P^{32}-labeled Bayer L 13/59 and DDVP, and their Absorption and Translocation in the American Cockroach.**—*J. econ. Ent.* **49** no. 6 pp. 808–812, 1 fig., 20 refs. Menasha, Wis., 1956.

Details are given of the preparation of ^{32}P-labelled Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] from radioactive red phosphorus, and of labelled DDVP [dimethyl 2,2-dichlorovinyl phosphate] by dehydrochlorination of this L 13/59, and also of studies of their absorption by and translocation in last-instar nymphs of *Periplaneta americana* (L.). The compounds were applied in solution in ethanol to the dorsal cervical membrane, and both were readily absorbed through it. In the case of L 13/59, the haemolymph and all tissues became radioactive. After 20 hours, most of the internal radioactivity was in the gut, though some remained in all tissues examined, and much activity remained external. The haemolymph of the cockroaches treated with DDVP did not become demonstrably radioactive, and many tissues became only slightly so. After two hours, much of the radioactivity was concentrated in the heart. After 22 hours, most of it was in the fat-body and only a small amount in the gut. The failure to detect radioactivity in the haemolymph was probably attributable to the low specific activity of DDVP, the small amounts applied in view of its high toxicity, and deposition in the tissues. No radioactivity could be removed from outside two hours after treatment.

BABERS (F. H.), MITLIN (N.) & SHORTINO (T. J.). **The Fate of Radiophosphorus ingested by House Flies and German Cockroaches.**—*J. econ. Ent.* **49** no. 6 pp. 820–822, 3 figs., 7 refs. Menasha, Wis., 1956.

A solution of ^{32}P as potassium dihydrogen phosphate was administered orally to *Blattella germanica* (L.) and *Musca domestica* L. in their food to study its effect on fertility. Five male and five female cockroaches were given treated food (meat-based dog biscuit containing 0·61 mc. ^{32}P per 2·8 g.) for 24 hours and then kept on normal food for 14 days. Their radioactivity when the food was changed showed that the amounts ingested were 0·37 mg. per male and 0·48 mg. per female. The males lost 50 per cent. of their radioactivity in about nine days but the females still retained 60 per cent. at the end of the experiment. Four of them developed oothecae, but these were flaccid, radioactive and contained no eggs. Newly emerged male and female flies that fed for three hours on dried skimmed milk containing 5 ml. ^{32}P solution (2·295 mc.) per 5 g., had initial radioactivities corresponding to 1·9 and 1·8 mg. milk and lost half their radioactivity in about 19 hours. Female flies that received ^{32}P-labelled food continuously for six days did not oviposit, but those that were returned to a normal diet at the end of this time laid a few eggs of low viability two days later. Flies kept on the ^{32}P for shorter periods also showed inhibited oviposition and fertility. Their ovaries were immature, but they recovered partly after a normal diet was given. Larvae reared on medium containing 15·3 μc. ^{32}P per g. (the highest concentration tested) developed into normal adults that laid normally fertile eggs. An experiment is described in which previously unfed adult flies were allowed to feed on radioactive diet and the time to first defaecation was observed. This varied from 1¾ to 2¼ hours and the faeces were highly radioactive.

GERSDORFF (W. A.). **Effect of Acetone on Toxicity in Pyrethrum and Allethrin Space Sprays.**—*J. econ. Ent.* **49** no. 6 pp. 849–851, 3 refs. Menasha, Wis., 1956.

When insecticides are compared by the Campbell turntable [*R.A.E.*, B **26** 246], the actual dosage of insecticide received by the insects is not measured. Conditions are so controlled that the amount of spray mist settling on the insects is the same in each test in any given series, and mortalities are related to the concentrations of insecticide in the original sprays. Insecticides in kerosene sprays have often been compared by the method, but it has been necessary to test some not sufficiently soluble in kerosene alone at the concentrations desired for the stock solutions, and acetone has been used as an auxiliary solvent. However, sprays containing an insecticide and acetone caused appreciably higher mortalities than those containing the same amount of insecticide in oil only, though acetone without insecticide caused no mortality. In 1945, pyrethrum extract was therefore tested against *Musca domestica* L. in refined kerosene, alone and mixed with acetone in several proportions, to examine the effect of the acetone, and to find if possible, a method of correlating relative toxicities estimated in sprays of different acetone content. The results of a statistical analysis of the data obtained form the subject of this paper.

The following is substantially the author's summary of them. When toxicity was calculated by the usual procedure, pyrethrins in mixtures containing 25, 50 and 75 per cent. acetone were, respectively, 1·51, 2·35 and 3·73 times as toxic as pyrethrins in kerosene alone, throughout the course of action. The action in the sprays containing 90 per cent. or more of acetone was quite different. The ratio of toxicity (R) of the pyrethrins varied geometrically as the proportion of acetone (pA) varied arithmetically between 0 and 75 per cent., the ratio corresponding to a 25 per cent. increment in acetone being 1·55. The equation showing this relationship is $R = e^{1\cdot758}\,pA$. The effect of acetone in allethrin sprays was about the same. The effect is apparent because of the method of comparing concentrations based on the original total volume and can be explained on purely physical grounds, as most of the acetone volatilises with a consequent increase in the dosage of insecticide applied to the insects. The relative toxicities of the toxicants are not affected, but it is necessary for valid comparisons to use standards with the same proportion of acetone to kerosene or to allow for differences in proportion.

Blum (M. S.) & Kearns (C. W.). **Temperature and the Action of Pyrethrum in the American Cockroach.**—*J. econ. Ent.* **49** no. 6 pp. 862–865, 10 refs. Menasha, Wis., 1956.

Increased toxicity at lower temperatures has been reported for various insecticides, including pyrethrum [*R.A.E.*, A **27** 231; **34** 376; B **39** 64; **41** 62], but the phenomenon has been little investigated. After pyrethrum extract had been found to have a negative temperature coefficient of action between 15 and 35°C. [59 and 95°F.] when applied topically to *Periplaneta americana* (L.), the 24-hour LD50 at the higher temperature being about six times that at the lower, possible correlations between toxicity and penetration, and the relationship between toxic materials in the blood (haemolymph) and symptomatic reaction were studied. It was determined in experiments in which a solution of pyrethrins labelled with ^{14}C was topically applied and observations made after 2 and 12 hours that the rate of penetration at 35°C. is more than twice that at 15°C. The ability of the cockroach to tolerate relatively high concentrations of pyrethrins was critically associated with its maintenance at a fairly high temperature. If treated and apparently unaffected cockroaches were transferred from 35 to 15°C., paralysis rapidly ensued, but they returned to normal when transferred back to 35°, and this process could be repeated for several hours. As cockroaches transferred from the higher to the lower temperatures became prostrate more rapidly than those kept continuously at 15°C., it is assumed that the insecticide (or a toxic metabolite) was near its site of activity at 35°C., but was ineffective.

The symptoms of poisoning manifested by pyrethrum-treated cockroaches were correlated with the concentration of a toxin in the blood as determined by bioassay from the duration of paralysis of adults of *Sarcophaga crassipalpis* Macq. into which 3 or 6 μl. blood was injected. Blood from treated cockroaches kept at 15°C. was toxic to the flies when the same amount from flies kept at 35°C. was not. Absence of radioactivity in the blood of cockroaches treated with ^{14}C-labelled pyrethrins indicated that the toxin was not a pyrethrin or metabolite. If cockroaches were treated with a high concentration of pyrethrins and became paralysed almost immediately, the toxicity to flies of blood removed several hours later was about the same as that of blood removed as soon as prostration had occurred. Piperonyl butoxide applied with the pyrethrum extract increased the susceptibility of the cockroach to it at higher temperatures, as indicated by observation of paralysis and by demonstration of the existence of the toxin by bioassay. Analysis showed that the synergist was present in the fat-body and the central nerve cord of the cockroach and absent in the blood. The toxic agent in blood lost almost all its activity when the blood was stored for three hours at room temperature (26–27°C. [about 80°F.]).

Mengle (D. C.) & Fisk (F. W.). **The Toxicities of certain Antibiotics to the German Cockroach.**—*Antibiot. & Chemother.* **6** no. 10 pp. 607–614, 1 graph, 13 refs. New York, N. Y., 1956.

Eighteen antibiotics were tested for toxicity to females of a chlordane-resistant and a normally susceptible strain of *Blattella germanica* (L.) by oral administration in the food and seven of them also by injection of solutions into the abdomen. In the feeding tests, the average amount of antibiotic eaten was found by offering 200 mg. test diet to 20 cockroaches, correcting the weight of unconsumed food by applying moisture factors derived from changes in the weight of samples to which cockroaches did not have access, and calculating the amount of antibiotic in the part eaten. In both series of experiments, mortalities were observed after 72 hours and LD50's determined from them. These are expressed as μg. per cockroach, but seven of the antibiotics were not toxic enough by oral administration for them to be ascertained. Xanthomycin hydrochloride had LD50's of 3·6 for the normal strain by injection and 24 and 22 for the normal and resistant strains by oral administration. It was not tested by injection against the resistant strain. The LD50's of the other antibiotics for the normal and (in brackets) resistant strain ranged from 19 (22) to 595 (600) for the six tested by injection and from 23 (22) to 1,450 (1,350) for the 11 toxic ones in the food; the injection LD50's were much lower than the oral ones for each of the six tested in both ways. Although the strains appeared to differ in susceptibility in several tests, the only significant difference shown by analysis was a greater susceptibility to injected dihydrostreptomycin sulphate in the chlordane-resistant than in the normal strain, for which LD50's were 39 and 49, respectively.

Finally, the effect of injecting penicillin, which was not included in the earlier tests, and dihydrostreptomycin sulphate on the susceptibility of the resistant cockroaches to subsequently injected chlordane was studied. The antibiotics increased the susceptibility of the cockroaches to chlordane injected one hour or, to a smaller extent, six hours, later. When injection of the chlordane was delayed for 24 hours, however, they did not modify its toxicity, presumably because they were no longer present in the insect in an unchanged state. Their effect, where evident, was found to be additive to the chlordane, not synergistic or antagonistic.

THOMPSON (R. P.) & HOSKING (W. F.). **A Count of Mallophaga on a heavily infested Hen.**—*Poult. Sci.* **36** no. 1 pp. 213–214, 6 refs. Ithaca, N. Y., 1957.

Few workers have attempted exact counts of lice infesting fowls. Those known to have done so have not recorded more than a few hundred per bird at most. The authors record the finding of much larger numbers on a hen that had died of natural causes and had previously been observed to be heavily infested by *Menacanthus stramineus* (Nitzsch) and lightly infested by *Menopon gallinae* (L.). The hen was put in a deep freeze when its body was still warm and was kept there for ten days, after which the lice on it were carefully removed, preserved and counted. The total number of lice found was 8,270, of which 92 per cent. were *Menacanthus* and the remainder *Menopon*, except for two individuals of *Goniocotes gallinae* (Deg.). The number of adults of all species was about equal to that of nymphs, and the sex ratio in *Menacanthus* was 1 : 1.

WALTON (G. A.). **Observations on biological Variation in** *Ornithodoros moubata* **(Murr.) (Argasidae) in East Africa.**—*Bull. ent. Res.* **48** pt. 4 pp. 669–710, 10 figs., 32 refs. London, 1957.

The following is substantially the author's summary. In the course of an investigation on the distribution and bionomics of *Ornithodoros moubata* (Murr.) in East Africa in relation to the incidence of relapsing fever, a survey was made of the infestation and the conditions of temperature and relative humidity in over 4,600 African huts. In Kenya Colony, relapsing fever is endemic in the high-rainfall areas of the Meru, Nyeri and Taita Districts [*cf. R.A.E.*, B **41** 130]. These mountainous areas are cool and wet, and microhabitats in tick-infested huts had a mean temperature of 71°F. and a mean relative humidity of 86 per cent. Tick infestations were relatively sparse and were rare in the hot and dry climate of Embu District, the base of the Taita Hills and generally over all such country in Kenya. In Tanganyika Territory, relapsing fever is widespread, and the tick was much more abundant, especially in the dry central areas. It is pointed out that although relapsing fever is most prevalent in the north-west, endemicity is at a lower level than in Kenya, and decreases towards the south-east. Thus, the degree of incidence of the disease does not conform with that of the vector. In the hot and humid Digo District, south of Mombasa on the Kenya coast [*cf.* **44** 129], the ticks were present only in the part of the area in which humidity was lowest and showed a reversal in their choice of microclimate from that in the cool highlands. Here, the mean relative humidity of the microhabitats in infested huts was 77 per cent. and the temperature 80°F. In the few huts that were not infested, the mean relative humidity was 89 per cent. and the mean temperature 77°F. The incidence of relapsing fever was very low. The ticks were widespread in the Usambara Mountain area of Tanganyika. They were most numerous in the cool, wet conditions above 4,000 ft., but were also abundant in the hot, moist foothills and plains, whereas they were absent from hot and dry country at the base of the Taita Hills in Kenya 80 miles to the north.

As humidity appeared to be a foremost factor affecting the distribution of *O. moubata*, it was not possible to evaluate clearly the effects of temperature. It is suggested that all the conflicting evidence of the relationship of the tick populations to microclimate and the incidence of relapsing fever may be explained only by introducing a hypothesis of biological variation in the tick itself. It is shown from an analysis by relative-humidity groups of all readings taken in tick microhabitats in the present work that there are two peaks of greatest tick abundance, at relative humidities of 86 and 67–68 per cent., respectively, and it is suggested that these two peaks represent the distribution of two hut-haunting biological forms.

An examination of the blood-meals from pooled catches by the precipitin test showed that the percentages of the recognisable feeds that were on man and (in brackets) on fowls were 94 (2) in the cool and wet habitats of the Kenya highlands and the north-west of Tanganyika, 18 (78) in the hot and moist habitats of Digo and the low-lying area between Digo and the Usambara Mountains [*cf.* **44** 129], and 73 (22) in the mainly warm and moist habitats of the Usambara Mountains and the area bordering the south-east of Lake Victoria. It is therefore suggested that one of the two biological forms of *O. moubata* found in huts feeds on man and the other on fowls. The former is found in huts at high altitudes in areas having a cool and wet climate. It shows a marked preference for the blood of man and ignores the presence of fowls, however numerous or available they may be. It occurs in greatest abundance at a relative humidity of about 86 per cent. and at relatively low temperatures (67–75°F.). It is absent from areas in which the relative humidity in the microhabitat is consistently over 90 per cent. and may not occur where it is consistently lower than about 74 per cent. The form that feeds on fowls appears to tolerate a wide range of temperature and relative humidity. It occurs in greatest abundance at 67–68 per cent. relative humidity and is found at temperatures varying from 68 to 87°F. It is more resistant to starvation than the form that feeds on man. Evidence is given indicating the existence of a third biological form, in the burrows of wart-hogs [*Phacochoerus aethiopicus*] [**44** 49] and porcupines (*Hystrix*), that does not appear to be associated with African huts. This form is extremely resistant to starvation. Experimental evidence is given that these three forms differ significantly in their egg-production characteristics. They can also be identified macroscopically with fair accuracy but cannot at present be separated on a morphological basis. From the evidence available, the distribution of the form that feeds on man is thought to include the southern half of the Belgian Congo, west to the Atlantic and east to Lake Victoria, with isolated pockets in highland areas scattered over East Africa to the Indian Ocean. The form that feeds on fowls extends from the southern shores of Lake Victoria to the Union of South Africa.

LEWIS (C. T.) & HUGHES (J. C.). **Studies concerning the Uptake of Contact Insecticides. II. The Contamination of Flies exposed to particulate Deposits.**—*Bull. ent. Res.* **48** pt. 4 pp. 755–768, 6 figs., 19 refs. London, 1957.

The following is based on the authors' summary of this paper, which is the second of a series [*cf. R.A.E.*, B **43** 1] and is an account of experiments in which adults of *Phormia terraenovae* R.-D. were exposed to finely particulate deposits of dyestuffs to obtain information on the precise sites of uptake of particles on the tarsi and pretarsi, the effects of cleaning movements on the position and retention of particles, and the influence of lipoid solubility (a fundamental property of contact insecticides) on the adhesion of dry particles to the lipophilic surfaces of insect and leaf cuticle. A technique for the controlled exposure of the active flies to particulate deposits is described. It was found that the rate of uptake of particles by walking flies decreases rapidly during the first few seconds of exposure. Particles are taken up principally by the ventral tarsal spines and in smaller quantities by the pulvilli. The frontal membranes of the contact chemoreceptors also become contaminated, but the intersegmental joint membranes are defended from particles by large spines that became heavily contaminated. Certain tarsal segments collect particles more efficiently than others and it appears that "hairiness" and the pressure of segments against the substrate are important variables affecting the rate of contamination. Cleaning movements continually transfer particles in constant proportions to the basal parts of tarsal setae, to the microtrichia of the tarsal cuticle, and to the head, wings and abdomen. It is considered that such transfer must greatly facilitate the toxic action of an insecticide deposit.

Most of the particles discarded by a contaminated fly are transferred from the tarsal setae to clean surfaces by a reversal of the pick-up process. These setae recover particles, by cleaning, from other parts of the body. A discarding mechanism of less importance is provided by the cleaning reactions in which fine particles are gradually combed into larger aggregates that can be knocked off. The rate of loss of particles from active flies is relatively rapid until the quantity retained has fallen to about 20 μg. and is very slow below 10 μg. Particles at any given dosage are discarded at the same rate whether they have been acquired during continuous or intermittent exposures of flies to deposits. Dry particles of a lipoid-soluble dye adhered more strongly to the cuticle of flies and to a leaf wax than did dry particles of one insoluble in lipoids. The presence of a mineral oil on a substrate hindered the uptake of particles of the lipoid-soluble dye to a marked degree, and it is concluded from this that previous findings that oily crystalline deposits of DDT are much more toxic to insects than dry ones [*cf.* **37** 229–230; **40** 109] are to be explained entirely by the effect of the oils in increasing the rate of penetration of the cuticle.

GRATWICK (M.). **The Uptake of DDT and other Lipophilic Particles by Blowflies walking over Deposits.**—*Bull. ent. Res.* **48** pt. 4 pp. 733–740, 2 graphs, 4 refs. London, 1957.

The following is virtually the author's summary. Estimations were made of the weight of material accumulated by adults of *Phormia terraenovae* R.-D. from deposits of DDT and other lipophilic particles in substrates of various types on which the flies were exposed. Uptake of dry DDT particles was similar to that of dry lipophilic dye particles of similar size, so that conclusions on the contamination of insects by dry lipophilic dyestuff [see preceding abstract] may be extended to contamination by DDT dust. The presence of oil greatly reduced the uptake of DDT particles from a fibrous substrate, the uptake decreasing logarithmically with increase in the amount of oil applied to the substrate. The viscosity of the oil had only a very small effect on the uptake of lipophilic particles from oily deposits and the solubility of the particles in oil had no significant effect.

A reduction in the uptake of dry lipophilic particles from filter paper and from a hard, waxy substrate occurred when a wetting-agent solution was applied immediately before the particles [*cf. R.A.E.*, B **40** 81]. When the particles were applied after the wetting agent had dried on the substrate, a reduction in uptake also occurred on the non-absorbent, waxy surface, but was smaller than when the particles were applied before the wetting agent had dried. No reduction in uptake occurred on the absorbent substrate under these conditions.

On the basis of the experimental results, the variations in the adhesion of lipophilic particles to substrates are discussed. It is concluded that while differences in the affinity of particles for substrates of different types cause variations in adhesion, the physical structure of the surface may be more important in determining the amount picked up from it. The presence of oil or wetting agent on the surface increases adhesion, probably by increasing both the affinity of the lipophilic particles for the substrate and the area of contact between particles and substrate.

GRATWICK (M.). **The Contamination of Insects of different Species exposed to Dust Deposits.**—*Bull. ent. Res.* **48** pt. 4 pp. 741–753, 4 figs., 7 refs. London, 1957.

The experiments described in this paper, which are noticed in more detail elsewhere [*R.A.E.*, A **46** 41], were concerned with the uptake of particles from a dust deposit of a lipophilic dye by insects representative of species that differ in size, hairiness of the tarsi or number of tarsal segments, and, in the case of one of the species (*Vespula vulgaris* (L.)), their distribution and loss during cleaning activity. It was shown that the total uptake per step during the first few steps on the deposit differed only slightly with the species, that the uptake by the hind legs was at least half the uptake by all legs, that the individual tarsal segments differed in collecting efficiency, and that tarsal setae helped to keep particles away from the main surface of the cuticle. The effect of vigorous cleaning activity was such that particles were lost from head, thorax and abdomen in the proportions in which they were acquired and were transferred in constant proportions from one region to another. The proportions of particles on the three pairs of legs also remained constant but the distribution on the tarsal segments changed.

It is concluded that an insecticide dust deposit is likely to be less effective against insects with tarsi that are densely clothed with setae than on those with fewer tarsal setae and more effective against insects that clean themselves frequently than on those that do so rarely. The effect of cleaning by insects that are densely clothed with setae may counteract any protection afforded by these setae.

LUMSDEN (W. H. R.). **The Activity Cycle of domestic** *Aëdes* (*Stegomyia*) *aegypti* **(L.) (Dipt., Culicid.) in Southern Province, Tanganyika.**—*Bull. ent. Res.* **48** pt. 4 pp. 769–782, 2 graphs, 27 refs. London, 1957.

The following is partly based on the author's summary. During an investigation of a severe epidemic of a virus disease that occurred among the population of the Makonde Plateau, Tanganyika, in 1952–55 [*R.A.E.*, B **43** 206–207], the opportunity was taken to study the cycle of biting activity of *Aëdes aegypti* (L.), which was extremely common in native huts on the plateau. Successive teams of four natives, one inside a hut and one on its verandah, caught the mosquitos that alighted on them over a continuous period of 49 hours, and the intensity of attack is expressed as the geometric-mean numbers of *A. aegypti* alighting per team per hour. The total numbers of females (and males) of *A. aegypti* taken were 1,973 (249) inside the hut and 621 (354) on the verandah. A considerable proportion of the population, particularly of the females, consisted of the pale form, and intermediates occurred [*cf.* **45** 134]. Females were active mainly by day, 66 and 69 per cent. of the catch inside the hut and on the verandah, respectively, being taken between sunrise and sunset. Inside the hut, there were four main peaks of biting activity, consistent on the two days of the catch and occurring about two hours before and three hours after sunrise and three hours before and four hours after sunset. Biting rates were about 50 females per hour at both night peaks, about 75 at the morning peak and about 90 at the afternoon one. There were signs of subsidiary peaks, including one soon after sunrise and one about midnight. On the verandah, there appeared to be six peaks of biting activity, of which four occurred at or about the same times as main or subsidiary ones inside the hut, but two, one about sunset and one three hours before sunrise, were not so related. There was less nocturnal activity among males than among females. The periodicity of incidence of males corresponded closely with that of the females both inside and outside the hut, except that males were virtually absent on the verandah by night.

The rhythms of activity are compared with those found by other workers and their possible causes discussed. It is concluded from the author's work and Teesdale's [**44** 6] that there are seven times at which increased activity may occur. It was stated in reports by E. Marchoux, A. Salimbeni & P. L. Simond (1903) and Marchoux & Simond (1906), on the basis of finding large numbers of females biting by day in a uniformly unworn condition, that in nature *A. aegypti* ceases to bite man by day after the first 6–8 days of adult life. The statement has not since been satisfactorily proved or disproved [*cf.* **9** 201–202; **17** 192], but it cannot be summarily dismissed. It is concluded that studies of the ages of mosquitos at the times of biting [*cf.* **40** 79], and of the periodicity of aspects of their behaviour other than biting are most likely to contribute to an understanding of the mechanism determining biting cycles.

BURGESS (L.) & BROWN (A. W. A.). **Studies on the Responses of the Female *Aëdes* Mosquito. Part VIII. The Attractiveness of Beef Blood to *Aëdes aegypti* (L.).**—*Bull. ent. Res.* **48** pt. 4 pp. 783–793, 2 figs., 16 refs. London, 1957.

In this eighth paper of a series [*cf. R.A.E.*, B **44** 85, etc.], an account is given of investigations carried out to ascertain whether mammalian blood is attractive to females of *Aëdes aegypti* (L.) and if so whether its attractiveness is due to the carbon dioxide in it. Blood collected weekly from freshly killed beef cattle, heparinised and stored in a refrigerator until needed, was used for the tests, in which the numbers of mosquitos attracted to the test substance and to a control material were compared. The following is based on the authors' summary. Vapour emanating from the blood was significantly more attractive than water vapour in an olfactometer, but lost this attractiveness when it was passed through a solution of barium hydroxide so that all carbon dioxide and possibly other substances were removed. When exposed on filter paper, the blood was 2–4 times as attractive as distilled water or washed corpuscles suspended in saline. Plasma proved to be 4·7 times as attractive as water, so that the attraction of the blood was shown to lie entirely in the plasma. Treatment of blood with barium chloride and a vacuum, which made it incapable of evolving carbon dioxide, removed its attractiveness to mosquitos. Treatment with vacuum alone, which may be expected to remove the volatile substance but leaves bicarbonate to evolve carbon dioxide, did not completely remove the attractiveness; nor did treatment with barium chloride alone, which removes the bicarbonates in the blood but leaves free carbon dioxide. Vacuum distillation removed a certain amount of a highly volatile attractive component but left the bulk of the attractive material in the blood. The attractiveness of blood was completely removed by desiccation and was not returned by remoistening. No attractive substance was isolated in an ether extract of blood. When blood that had been made carbon-dioxide free was treated with gaseous carbon dioxide, its attractiveness was significantly increased, but when the treatment was such as to restore the normal capacity for producing carbon dioxide, the attractiveness was only half that of whole blood. The attractiveness of whole blood was not increased by the addition of excess carbon dioxide.

It is concluded that the carbon dioxide in ox blood is a definite element in its attractiveness [*cf.* **25** 171], though probably not the most important.

PHILLIPSON (J.). **The Effect of Current Speed on the Distribution of the Larvae of the Blackflies,** *Simulium variegatum* **(Mg.) and** *Simulium monticola* **Fried. (Diptera).**—*Bull. ent. Res.* **48** pt. 4 pp. 811–819, 6 graphs, 12 refs. London, 1957.

Having shown that the choice of lowland streams by *Simulium ornatum* Mg. could be explained on the basis of current flow [*R.A.E.*, B **44** 131], the author carried out investigations in northern England in 1955 and 1956 on the reactions of larvae of *S. variegatum* (Mg.) and *S. monticola* Fried., species typical of fast-flowing highland streams, to currents of different velocities. Except in waterfalls during heavy spates, the greatest velocity met with was 300 cm. per second. The observations in 1955 were made in Cross Gill in Cumberland in June and July and in Troutbeck in Westmorland in July, and the only species identified was *S. monticola*. The results suggested that the greatest numbers of larvae occur in the velocity range 76–200 cm. per second; higher velocities were not obtained because of the prolonged drought. In laboratory experiments with velocities decreasing from 125–150 cm. per second, larvae released their hold below 100 cm. In 1956, observations were made in Cross Gill in July, and larvae, virtually all of which seemed to be *S. variegatum*, were found in the range 51–250 cm. per second with the greatest abundance at 150–175 cm. In laboratory experiments, most larvae subjected to decreasing velocities released their hold at 51–75 cm. per second or less and others that had established themselves at 100–150 cm. and were subjected to increased velocity, generally remained attached at 100–225 cm., but released their hold between 225 and 300 cm.

A list of velocity records for species of *Simulium* known to occur in Britain is compiled from the literature. The ranges for *S. variegatum* and *S. monticola* appear to be almost identical (30–250 cm. per second) and to overlap that of *S. ornatum* (18–120 cm.) and very slightly that of *S. venustum* Say (17–82 cm.). The fact that the larvae of *S. variegatum* and *S. monticola* can endure relatively large changes in current speed and maintain their position at high stream velocities indicates that they are well adapted to withstand spate conditions. Velocity alone could explain species distribution in water courses, but the fact that the field population in Cross Gill was wholly *S. monticola* in 1955 and almost wholly *S. variegatum* in 1956 shows that other factors play a part. The different ranges used by the various species serve to reduce inter-specific competition.

FALES (J. H.), FULTON (R. A.) & BODENSTEIN (O. F.). **Low-pressure insecticidal Space Sprays.**—*Aerosol Age* **1** no. 8 pp. 35–38, 1 graph, 6 refs. Caldwell, N. J., 1956.

A typical solution for a low-pressure insecticidal aerosol [*cf. R.A.E.*, B **38** 205] contains about 80–85 per cent. of a mixture of equal parts of dichlorodifluoromethane and trichlorofluoromethane as the propellent. To obtain the correct particle size, aromatic petroleum-derivative solvents with a boiling range of 300–650°F. and deodorised kerosene are used instead of more viscous solvents and oils. The possibility of reducing costs by increasing the ratio of kerosene to the propellent mixture has been investigated [**38** 206], but a formula has subsequently been developed in which the trichlorofluoromethane is entirely replaced by deodorised kerosene. It produces larger particles than those specified for the standard aerosol [**40** 26], and is called a low-pressure space spray. Tests of the effectiveness of sprays of this type are described. Unless otherwise stated, they were made by the Peet-Grady method [**44** 25] against *Musca domestica* L.

In a comparison of kerosene sprays containing DDT alone or with pyrethrins and dispersed by the Peet-Grady atomisers at the usual pressure of 12·5 lb. per sq. in. and also at pressures of 50 and 100 lb. (which gave particles with mass median diameters of 30–40, 18–25 and 10–18 μ, respectively), the highest rates of knockdown and kill were obtained with 50 lb. per sq. in. A low-pressure spray formula (G-1170) with the same active ingredients as the OTA (2 per cent. DDT and 2 per cent. pyrethrum extract containing 20 per cent. pyrethrins) but with 51 per cent. deodorised kerosene, 5 per cent. methylene chloride and 40 per cent. dichlorodifluoromethane in place of 6 per cent. petroleum derivatives, 5 per cent. deodorised kerosene and 85 per cent. of the 1:1 mixture of propellents was nearly as effective as the OTA when applied at two dosages from containers equipped with a commercially available metal-diaphragm aerosol valve, and a similar one (G-1171) with the active ingredients halved was only a little less effective than G-1170. The mass median diameter and (in brackets) the diameter of the largest particle were 29 (52·4) μ for G-1170, 27 (55·8) μ for G-1171 and 17·7 (49·3) μ for the OTA. When G-1170 was tested with 11 different plastic valves, satisfactory spray rate, particle size, knockdown and kill were obtained with a commercially available valve that had a reverse taper button with a 0·018-inch outer orifice, a 0·022-inch orifice in the nylon body and a 0·018-inch metering orifice in the brass stem. Six other space-spray formulations gave rather less mortality when dispensed from this valve than when the same insecticides were used in aerosol form, but in general, performance was not very different. G-1170 compared favourably with the OTA in knockdown and kill of *Anopheles quadrimaculatus* Say exposed in the Peet-Grady chamber for five minutes, and the two formulations gave equal control of *M. domestica*, *A. quadrimaculatus* and *Aëdes aegypti* (L.) when compared in a room with a capacity of 2,160 cu. ft. When 25 or 50 per cent. of the trichlorofluoromethane in the OTA was replaced by kerosene, effectiveness against *M. domestica* was not reduced, but there was a gradual reduction in effectiveness as the dichlorodifluoromethane in G-1170 was replaced by kerosene. In 26 comparisons against *M. domestica*, G-1170 was 8 per cent. less effective than the OTA in 15-minute knockdown and 6 per cent. less effective in one-day kill. It is suggested that G-1170 be used as a standard for evaluating low-pressure space sprays.

MATTINGLY (P. F.). **The Culicine Mosquitoes of the Indomalayan Area. Part II. Genus** *Heizmannia* **Ludlow.**—57 pp., 32 figs., 23 refs. London, Brit. Mus. (Nat. Hist.), 1957. Price 12*s*. 6*d*.

This paper is the second part of a revision of the CULICINI of the Indomalayan area [*cf. R.A.E.*, B **45** 199]. Nine species of *Heizmannia* are recognised from the area, of which three are new. The genus shows resemblances to *Haemagogus*, which is purely Neotropical, but in which three Oriental species were included by Edwards [**10** 229; **21** 1] and Barraud [**17** 256; **22** 86]. Of these, *Haemagogus achaetae* (Leic.) is transferred to *Heizmannia* and *Haemagogus discrepans* Edw. [**10** 198] and *H. tripunctatus* (Theo.) to *Aëdes*.

In addition to the matter concerned directly with *Heizmannia*, the paper also contains keys to enable the adults of each sex, pupae and fourth-instar larvae of the genera and subgenera so far dealt with in this revision to be distinguished from those of all other genera of CULICINI. They are to be expanded in later papers of the series, and so will include what is believed to be the first world key to pupae yet produced.

KELLER (J. C.), CLARK (P. H.) & LOFGREN (C. S.). **Susceptibility of Insecticide-resistant Cockroaches to Pyrethrins.**—*Pest Control* **24** no. 11 pp. 14–15, 30, 2 refs. Painesville, Ohio, 1956.

Strains of the German cockroach [*Blattella germanica* (L.)] received at the Orlando laboratory of the United States Department of Agriculture from various parts of the United States over a period of four years all showed resistance to chlordane, dieldrin and γ BHC (lindane) [*cf. R.A.E.*, B **46** 16]. In this paper, the results are given of tests of the susceptibility of 12 such wild strains to sprays and deposits of pyrethrins. All the strains except one had been reared in the laboratory for various periods without further exposure to insecticides. To test contact sprays, 0·5 ml. of a solution of pyrethrins in odourless kerosene was atomised at 4 lb. per sq. inch and drawn through a wind tunnel [**38** 148] containing a cage of ten male cockroaches. The solutions contained 0·025–1 per cent. pyrethrins alone or combined with ten times the amount of piperonyl butoxide. The cockroaches were removed to a clean cage after treatment. Data, based on 4–8 tests with each strain and concentration, are given on knockdown after 10, 30 and 60 minutes and mortality after 24 hours. On the basis of the concentration required for 50 per cent. mortality, one strain (Fort Rucker) was 13 times as resistant to pyrethrins alone and eight times as resistant to pyrethrins with piperonyl butoxide as the regular laboratory strain; four other strains were slightly resistant to the pyrethrins alone and at least two of them to the pyrethrins and synergist.

When males of *B. germanica* were confined under plastic containers on masonite panels sprayed with acetone solutions containing pyrethrins and piperonyl butoxide (1 : 10) to give a deposit of 20 mg. pyrethrins per sq. ft., the Fort Rucker strain was again the most resistant, being 20 and 31 times as resistant as the normal strain on the basis of the periods of exposure needed to give 50 and 90 per cent. mortality, respectively. All the other strains, with two possible exceptions, were resistant to some extent.

RAMACHANDRA RAO (T.) & HALGERI (A. V.). **A Note on Resistance of Bed Bugs to D.D.T. in Bombay State.**—*Indian J. Malar.* **10** no. 2 pp. 149–154. Kanpur, 1956.

Reports that DDT had lost its initial effectiveness against bed-bugs (*Cimex hemipterus* (F.)) were received in 1951–54 from several parts of Bombay State in which it had been extensively used in houses against Anophelines, and its failure to control the bugs reduced the readiness of people to have their houses treated. Complaints were worst from warm, humid districts, and were made earlier when DDT had been used as a suspension than when it had been used in emulsified solution. The toxicity of DDT to bed-bugs collected in Poona City was tested in 1952, when it was first reported to be ineffective there, and again in 1955 by exposing adults on filter papers thinly coated with dusts of technical DDT in talc. Over 50 per cent. kill was obtained in 1952 by exposure for two or four minutes to dusts containing 5 or 2 per cent. DDT, respectively, whereas exposure for ten minutes to 2 or 5 per cent. dusts caused no mortality in 1955, while exposure for 30 minutes to 25, 50 and 75 per cent. dusts and to an undiluted dust of technical DDT (which does not adhere to the bugs so well as the talc mixtures) gave 16, 54, 45 and 6·6 per cent. kill. In Chiplum Town (Ratnagiri District), which had not been sprayed and is some 80 miles from the nearest sprayed area, exposures for four and ten minutes to 5 per cent. dust caused 33·3 and 66·6 per cent. mortality. Good control of bed-bugs has recently been obtained by using dieldrin or BHC in some houses in which they had become a nuisance.

Freyvogel (T.). **Malaria in tiefer und mittlerer Höhenlage. Untersuchungen in endemischen Gebieten Tanganyikas.** [Malaria at low and medium Altitudes. Investigations in endemic Areas of Tanganyika.]—*Acta trop.* **13** no. 1 pp. 58–81, 4 graphs, 8 refs. Basle, 1956. (With Summaries in French and English.)

It has long been known that malaria patients of white race benefit from a stay at an Alpine health-resort, and experiments in Switzerland by the author and others have shown that the initial development of the exo-erythrocytic forms of *Plasmodium gallinaceum* in chicks is retarded at high altitudes (11,500 ft.). However, this retardation is only temporary, and the course of blood infection is the same as in a valley. To ascertain whether high altitude had the same effect on Africans as on Europeans and on human malaria parasites as on *P. gallinaceum*, a survey was made in 1954 in two villages in southern Tanganyika, one of them (Ifakara) at an altitude of 770 ft. and the other (Kwiro) at 3,300 ft. Both were in territory of endemic or probably holoendemic malaria, and *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovale* were all present. Preliminary studies showed that the same increase in the number of erythrocytes and their haemoglobin content occurred in Africans at 3,300 ft. as in Europeans at higher altitudes. Questioning of white missionaries of the region yielded evidence that malaria had been less frequent among them in Kwiro than at lower altitudes. A statistical survey showed that fewer people develop malaria in Kwiro than in Ifakara, but that those who do become infected show the same severe symptoms and even more relapses. The data indicate that the lower incidence of the disease in Kwiro cannot be attributed solely to the smaller number of Anopheline vectors, as there was no significant difference in the proportion of infants becoming infected in the two areas. Independently, the experiments on fowls in Switzerland and the observations on man in Africa lead to the conclusion that the resistance of the reticulo-endothelial system, especially to the pre-erythrocytic stages of development of the parasite, is stimulated at high altitudes. The similarity of the results indicates that they probably apply to all warm-blooded animals, but the exact way in which the same result is reached in different hosts is not known.

Wu (Chiao-ju) & Wu (Shu-yin). **Isolation of Virus of B Type Encephalitis from** *Lasiohelea taiwana* **Shiraki—a blood sucking Midge.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 1 pp. 22–26, 2 refs. [Peking] 1957. **The Species of Mosquitoes transmitting Japanese B Type Encephalitis in Fukien.** [*In Chinese.*]—*T. c.* pp. 27–32, 4 refs. (With Summaries in English.)

The investigations that are the subject of these two papers were carried out in a part of Fukien in which Japanese B encephalitis was epidemic, and those described in the first were promoted by a local belief that *Lasiohelea taiwana* (Shiraki) was acting as a vector. During July and August 1955, 763 adults of this Ceratopogonid were caught when settling on the authors and were examined for virus by inoculation of suspensions into test animals. One strain of the virus, identified serologically and biologically, was isolated from a batch caught in July, when the epidemic was at its height.

Eight isolations of the virus from mosquitos are recorded in the second paper. One was from adults of *Culex pipiens fatigans* Wied. caught in dwellings, but the other seven were from adults of *Aëdes albopictus* (Skuse) reared from larvae found in breeding places near the homes of infected people. The occurrence of the virus in the reared mosquitos supports the suggestion that it can be carried from one generation to the next through transovarian transmission [*cf. R.A.E.*, B **31** 3].

Hudson (B. N. A.). **The Behaviour of the Female Mosquito in selecting Water for Oviposition.**—*J. exp. Biol.* **33** no. 3 pp. 478–492, 8 graphs, 12 refs. London, 1956.

The following is virtually the author's summary. Egg-laying females of *Culex pipiens molestus* Forsk. and *Aëdes aegypti* (L.) were able to discriminate between solutions of sodium chloride ranging from 0 (distilled water) to 0·136 M (8 g. per litre) [*cf. R.A.E.*, B **43** 203; **44** 164]. Significantly fewer eggs were laid in solutions above 0·085 M. Similar series of solutions of potassium chloride, magnesium chloride and sodium sulphate showed a similar distribution of eggs, but mosquitos were apparently unable to distinguish between solutions of magnesium sulphate with concentrations below 0·144 M. Results from all these salts were related to the osmotic pressures produced, but experiments in which isotonic solutions of glucose and sodium chloride were offered simultaneously, showed that osmotic pressure was not a critical factor. Experiments were carried out to locate the sensory areas responsible for discrimination. The possibility that drinking might be associated with the choice of a solution for egg-laying was investigated by removing the proboscis; operated insects were still able to detect differences in concentration. Covering or removing various regions of the legs revealed that the chemoreceptors concerned were distributed on all the tarsi [*cf.* **43** 204]; indications that they may also be found on the tibiae were obtained.

Baines (S.). **The Role of the symbiotic Bacteria in the Nutrition of *Rhodnius prolixus* (Hemiptera).**—*J. exp. Biol.* **33** no. 3 pp. 533–541, 15 refs. London, 1956.

The following is virtually the author's summary. Earlier views of the nature of the association between *Rhodnius prolixus* Stål and its symbiotic bacteria are confirmed [*cf. R.A.E.*, B **24** 155; **32** 234]. The bacterium, originally described as *Actinomyces rhodnii*, is redescribed and placed in the genus *Nocardia* in accordance with more recent views of the classification of the Gram-positive filamentous bacteria. Experimental evidence is provided to show that it is essential to *Rhodnius* because of its function in supplying certain B group vitamins, in which the normal blood diet of the host is deficient.

Mead-Briggs (A. R.). **The Effect of Temperature upon the Permeability to Water of Arthropod Cuticles.**—*J. exp. Biol.* **33** no. 4 pp. 737–749, 4 figs., 17 refs. London, 1956.

The following is virtually the author's summary. The effect of temperature alone upon the permeability of arthropod cuticles was investigated by measuring the rate of transpiration into a constant saturation deficit at a number of temperatures. The permeability of the cuticles of a woodlouse (*Oniscus asellus* L.) and a centipede (*Lithobius* sp.) was little affected by temperature. The cuticles of adults of *Calliphora vicina* R.-D. (*erythrocephala* (Mg.)), *Glossina palpalis* (R.-D.), *Blatta orientalis* L. and *Periplaneta americana* (L.) became progressively more permeable as the temperature was raised from 30 to 50 or 55°C. [86 to 122 or 131°F.]. That of larvae of *Tenebrio molitor* L. behaved similarly, but the increase in permeability was less marked until the temperature rose above 40°C. [104°F.]. The progressive increase in permeability of the cuticle of *Periplaneta* was entirely eliminated if the soft wax coating was removed. The increase in permeability of the insect cuticle with temperature is approximately exponential and cannot result from a single, abrupt change in a wax layer at a critical temperature [*cf. R.A.E.*, A **34** 60, 61]. Possible physical bases for a continuous change are discussed.

Bursell (E.). **The Effect of Humidity on the Activity of Tsetse Flies.**—*J. exp. Biol.* **34** no. 1 pp. 42–51, 1 graph, 17 refs. London, 1957.

The effect of relative humidity on the activity of tsetse flies was investigated by observing the frequency of movement of individual flies, chiefly *Glossina morsitans* Westw., confined singly in glass dishes that had glass lids on which grids were marked and false floors of muslin over receptacles containing the solutions for humidity control. The flies frequently remained in the same place for ten hours or more under these conditions, and the activity of each was determined by noting its position relative to its grid every ten minutes of each alternate hour between 8 a.m. and 5 p.m. and rated by expressing the number of changes in position as a percentage of the possible number (30). There was no difference in the results of tests carried out at 25°C. [77°F.] and at temperatures varying between 25 and 30°C. [86°F.].

The curve of activity of unfed teneral flies fell gradually as the humidity increased from 0 to 80 per cent., and the fall was in general more pronounced at higher humidities. The higher level of activity in dry than wet air was maintained throughout the observation period. Flies that had emerged on the previous day were least active at 90 per cent. humidity; those that had emerged two days before were least active at 100 per cent. and more active at all other humidities than the one-day flies. Non-teneral flies that had fed showed less than 1 and 10 per cent. activity on the first and second days after the meal, with no humidity reaction, but the reaction was well established on the third day, with minimum activity at 80 per cent. humidity, and was more intense on the fourth with the minimum at 100 per cent. In these experiments, the humidities at which the teneral and fed flies were kept before test were 80 and 50 per cent., respectively. Starvation in unsaturated air decreases both fat and water contents of the flies, but a further experiment showed that loss of water was the factor in the reaction, since the activity percentages at 0 and 98 per cent. humidity were 46·3 and 15·8 for a group of teneral flies starved for two days at 50 per cent. humidity as compared with 15·4 and 12·9 for a group starved at 100 per cent., and analysis showed that the first group contained quite as much fat as the second but significantly less water.

The humidity reaction did not occur at all if the light intensity was less than that from a cloudless sky at sunset, but did not vary with differences in amount of light above this critical point. Flies blinded with black wax on the compound eyes did not react to humidity, but blinding or removal of the ocelli did not affect the reaction, though their removal caused the general level of activity to be doubled. Covering the antennae with wax, removing the wings or lacquering the tarsi did not prevent the reaction, but it was eliminated and the general level of activity at different light densities markedly increased when the branched sensory hairs guarding the thoracic spiracles were removed; flies treated in this way fed and survived normally and their rate of water loss was not increased. These spiracular filters are accordingly believed to be responsible for the humidity reaction. Owing to their position, they are in contact with water lost through the spiracles, as well as with atmospheric humidity, and so are in contact with decreasing amounts of water at a given humidity as the spiracles close.

Four other species of *Glossina* were included in the tests and all showed the humidity reaction. The activity percentages at 0 and (in brackets) 98 per cent. humidity of flies that had emerged two days before were 48 (20) for *G. pallidipes* Aust., 33 (18) for *G. austeni* Newst., 24 (14) for *G. swynnertoni* Aust., and 79 (61) for *G. palpalis fuscipes* Newst., as compared with 23 (9) for *G. morsitans*. The reaction was significant in each species and strongest in *G. pallidipes*, though the general level of activity was twice as high in *G. palpalis fuscipes* as in the four members of the *morsitans* group. In discussing the relation of the reaction to the habitat of savannah tsetses. where differences in humidity are very slight, the author states that a resting fly normally loses enough water in ten minutes to saturate 1·3 cc. of air. Thus the reaction may cause a fly to move away from an exposed resting place, where the water lost through its spiracles is quickly dissipated, and remain in a sheltered one where some of the vapour is retained round it.

VARMA (M. G. R.). **Comparative Studies on the Transmission of two Strains of** *Spirochaeta duttoni* **by** *Ornithodoros moubata* **and of** *S. turicatae* **by** *O. turicata*.—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 1–17, 24 refs. Liverpool, 1956.

The ticks used in this study were *Ornithodoros moubata* (Murr.) and *O. turicata* (Dugès), and the spirochaetes were a strain of *Borrelia* (*Spirochaeta*) *turicatae* and two strains of *B.* (*S.*) *duttoni* of which one (Wellcome) was originally isolated from man and had been maintained in serial passage in mice since 1926 and the other (Ifakara) had been maintained by tick-mouse-tick passage since its isolation from *O. moubata* in Tanganyika in 1949. The work was directed mainly towards the elucidation of the factors responsible for an observed low rate of infection of *O. moubata* with the Wellcome strain and the apparent inability of the tick to transmit it.

The following is substantially the author's summary. Examples of a laboratory strain of *O. moubata* that had fed as nymphs on animals infected with the Wellcome strain of *B. duttoni* failed to transmit the spirochaetes during subsequent test-feeds, and their coxal fluid was negative on microscopical examination and inoculation into mice. However, the spirochaetes were shown by test inoculation to be conserved in the ticks for as long as 118 and 135 days, though such positive results by inoculation were infrequent. Presumptive ability to transmit the spirochaetes, as shown by infection of the salivary and coxal glands, was demonstrated in a few ticks. One salivary-gland infection developed in eight days, but some ticks kept for up to 446 days remained negative. The rate of infection of the tick organs by the spirochaetes was not noticeably increased by increasing the number of infecting feeds from one to three, and no transmission occurred. Attempts to make the Wellcome strain transmissible by passage through ticks were unsuccessful or inconclusive. Although a " wild " strain of *O. moubata* from Mwanza, Tanganyika, showed a higher rate of infection with the Wellcome spirochaetes than the laboratory strain, the results, in view of the small numbers of ticks used, did not suggest that the non-transmissibility of the strain was due to a factor in the ticks. Females of *O. moubata* that were inoculated intrahaemocoelically with the Wellcome strain later transmitted the spirochaetes naturally during feeding, and excreted infective coxal fluid. Spirochaetes were found in the organs of all the inoculated ticks that were dissected, which suggests that the gut wall acts as a partial barrier to the passage of Wellcome *B. duttoni* from the gut to the haemocoele.

Unlike the Wellcome strain, the Ifakara strain of *B. duttoni* was transmitted naturally by *O. moubata* during feeding and excreted in the coxal fluid. It was shown to be more infective for the ticks than the Wellcome strain. It is suggested that the prolonged maintenance of the Wellcome strain in mice may have modified the characteristics of the spirochaetes in a way that reduced their ability to penetrate the tick's gut wall and so to establish infection of the internal organs, particularly the salivary and coxal glands. A comparison of the frequency of transmission of *B. turicatae* by *O. turicata* with that of Ifakara *B. duttoni* by *O. moubata* gave results that, although not statistically significant, suggest that *O. turicata* may be a more efficient vector than *O. moubata*.

VARMA (M. G. R.). **Infections of *Ornithodoros* Ticks with Relapsing Fever Spirochaetes, and the Mechanisms of their Transmission.**—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 18–31, 60 refs. Liverpool, 1956.

The following is substantially the author's summary of this account of further investigations [*cf.* preceding abstract] in which the same strains of ticks and spirochaetes were used. The haemolymph of 43 individuals of *Ornithodoros moubata* (Murr.) infected with *Borrelia* (*Spirochaeta*) *duttoni* by feeding or inoculation, and five of *O. moubata* and ten of *O. turicata* (Dugès) infected with *B.* (*S.*) *turicatae* by inoculation was examined on the day on which the ticks were dissected. The findings showed that infection of the haemolymph, as revealed by microscopical examination, is not a consistently reliable indication of organ infection, which was present in all cases. The haemolymph of *O. turicata* was more often apparently free from spirochaetes than that of *O. moubata* infected with either spirochaete. The apparent absence of spirochaetes from the haemolymph is probably attributable to their being so greatly reduced in numbers that they escape detection by microscopical examination. However, no evidence was produced to exclude the possibility of their having a granular stage [*cf. R.A.E.*, B **28** 66, etc.] or a true negative phase. An analysis of infection of different organs of *O. moubata* with *B. duttoni* showed that the central ganglion was the most often infected, followed, in order of descending frequency, by the coxal glands, the salivary glands, the reproductive organs, Géné's organ and the Malpighian tubules. The frequency of infection of the salivary glands and the coxal glands was about the same, but the proportion of ticks showing heavy infections of the coxal glands was higher than that showing heavy infections of the salivary glands. In infections of *O. turicata* and *O. moubata* with *B. turicatae*, the salivary glands were most frequently infected, followed by the coxal glands, the central ganglion, Géné's organ, the reproductive organs and the Malpighian tubules, in that order. The frequency of infection of the central ganglion was significantly higher for *B. duttoni* than for *B. turicatae*. The frequency of infection of the ovaries of *O. moubata* with *B. duttoni* was significantly higher than the frequency of infection of the ovaries of *O. turicata* with *B. turicatae*.

There was no significant difference in the intensity of infection of the salivary glands, coxal glands, central ganglion or reproductive organs between examples of *O. moubata* fed on animals infected with the Ifakara or Wellcome strain of *B. duttoni* and those inoculated with the Wellcome strain, or between *O. turicata* and *O. moubata* inoculated with *B. turicatae*. In all cases, Géné's organ and the Malpighian tubules were only lightly infected. Infections of the salivary glands of adults of *O. moubata* were heavy in five of ten inoculated with *B. duttoni*, but in only four of 23 infected by feeding when young nymphs. This suggests that the low frequency of heavy infections of the salivary glands of adults was probably due to the lapse of time after their infecting meal in early nymphal life.

The parts played by the salivary secretion and the coxal fluid in the transmission of *B. duttoni* by *O. moubata* and *B. turicatae* by *O. turicata* are discussed. In eight test-feeds by *O. turicata*, all of which effected transmission, the coxal fluid was either not emitted or was negative on examination for spirochaetes. Transmission in this species was therefore entirely by bite, though spirochaetes entered the coxal glands of nine out of ten examples inoculated intrahaemocoelically. Coxal fluid was emitted, and contaminated the wound, in all of 16 test-feeds by *O. moubata*, but transmission was effected by only five of the feeds, and these five included the only three in which spirochaetes could not be detected in the fluid. Nymphs and young adults transmitted the infection more readily than old adults, probably because infection of the salivary glands in old adults either dies out or decreases in intensity [*cf.* **41** 96].

DUKE (B. O. L.). **The Intake of the Microfilariae of** *Acanthocheilonema perstans* **by** *Culicoides grahamii* **and** *C. inornatipennis*, **and their subsequent Development.**—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 32–38, 1 fig., 5 refs. Liverpool, 1956.

By weighing unfed and fully gorged adults singly or in groups of 2–10 on a torsion balance, it was shown that the mean weights of unfed individuals of *Culicoides grahamii* Aust. and *C. inornatipennis* C., I. & M. taken in nature [in the British Cameroons] are 0·035 and 0·063 mg., respectively, and the mean weights of blood taken up by the two species at one meal are 0·044 and 0·065 mg. The intake of microfilariae was estimated by allowing wild-caught adults to feed to repletion on the lower limbs (below the knee) of an infected volunteer, killing them immediately, and examining smears of the ingested blood-meals on slides after dehaemoglobinising, fixing and staining them. Natural infection in locally caught midges was shown to be negligible. The geometric means of the actual and (in brackets) expected intakes of *Dipetalonema* (*Acanthocheilonema*) *perstans* were 1·67 (2·07) microfilariae per fly for *C. grahamii* and 1·43 (3·19) for *C. inornatipennis*. With *Loa loa*, the corresponding figures were 0·02 (0·37) and 0·15 (0·51). None of the midges examined took in the microfilariae of *Onchocerca volvulus*, which were present in the skin on which they fed, and none took in those of *D.* (*A.*) *streptocerca*, which were present in the skin of other parts of the volunteer's body but not in the legs below the knees. Development of ingested microfilariae to the infective stage took place in eight out of 138 adults of *C. grahamii* and seven out of 17 of *C. inornatipennis*. The author concludes from his earlier observations on the development of microfilariae in *C. grahamii* [*R.A.E.*, B **44** 10] that the parasites concerned were not *Loa loa* and therefore must have been *D. perstans*.

PARKER (A. H.). **Laboratory Studies on the Selection of the Breeding-site by** *Glossina palpalis*.—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 49–68, 4 figs., 13 refs. Liverpool, 1956.

The following is substantially the author's summary. Investigations into the responses involved in the selection of breeding sites by pregnant females of *Glossina palpalis* (R.-D.) were carried out in the laboratory in Nigeria. The females were kept in a room with various objects on the floor until at least 100 had larviposited, and the attractiveness of the objects was then estimated from the numbers of pupae on, in or round them. A variety of black objects exercised a strong attraction, apparently owing to a visual response by the females, and black objects that included vertical surfaces were more attractive than those with only horizontal components. The attractiveness of the objects owed little to the presence of shade. A suggestion that the special attractiveness of black objects that provided enclosed nooks was due to an additional non-visual response was not confirmed in further investigation. Soil shaded by wooden screens, a small log or withered leaves was much more attractive than unshaded soil. Shade-casting screens were apparently attractive only by virtue of the visual effects that they produced. This finding and the lack of a non-visual response to enclosed nooks suggested that objects at breeding sites were not important in providing congenial resting places for the larvipositing females.

The addition of sand to a dark situation increased its attractiveness, even though it made it appear lighter. This suggests the existence of a non-visual attractive element. A preference for rough- over smooth-surfaced soil, displayed under conditions that eliminated difference in appearance, strongly indicated that this attractive element was tactile. Soils composed of mobile particles were not preferred to those composed of immobile particles. Forest soil was preferred to river-bed sand, possibly because it was darker. Dry forest soil and fallen leaves from a natural breeding site apparently had no odour attractive to the females. Soils with a moisture content of 25 per cent. or more were avoided in favour of those in equilibrium with the atmosphere, both when the relative humidity was about 50 per cent. and when it was about 80 per cent. There was no discrimination between soils with a moisture content above 25 per cent. Temperature readings taken in natural breeding sites at the time of maximum larviposition (between noon and 3 p.m. in a shaded outdoor area) showed that the temperature was as much as 3·5°C. [6·3°F.] lower inside the sites than just outside. In the laboratory, the females apparently did not discriminate between soil at the room temperature of about 25°C. [77°F.] and soil 3·5°C. cooler; they avoided soil more than 3·5°C. cooler than the atmosphere in favour of uncooled soil.

Direct observation of larviposition in an observation box showed that all depositions occurred on the soil surface and nearly all in the shade. These sites were not the preferred resting places of the females in the box as a whole. The time actually spent in the breeding site by 13 females averaged 45 minutes before larviposition and 18 minutes afterwards. The significance of the results in nature is discussed. The responses observed, if they occur to the same extent in the field would largely account for the distribution of pupae there.

PARKER (A. H.). **Experiments on the Behaviour of** *Glossina palpalis* **Larvae, together with Observations on the natural Breeding-places of the Species during the wet Season.**—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 69–74, 14 refs. Liverpool, 1956.

The following is substantially the author's summary. Experiments on the behaviour of larvae of *Glossina palpalis* (R.-D.) were carried out in a laboratory near Kaduna in Nigeria, and an attempt was made to discover the natural wet-season breeding places of the species in the same locality, which is near the northern limit of its range [*cf. R.A.E.*, B **42** 154] and thus in the hottest and driest part of it. Larvae were found to burrow more readily into rough- than into smooth-surfaced soil, and more readily into dry than into damp soil. They showed strong negative phototropism in the presence of the light from an electric bulb, but burrowing did not depend on avoidance of light, as it took place to an equal extent in light and in complete darkness.

Attempts to discover the wet-season breeding sites met with little success, only five living pupae being found in over 200 hours' searching, and only one of them in a site unlikely to be occupied during the dry season. That some seasonal change in the distribution of the breeding sites does occur, however, is obvious in cases where flooding makes dry-season sites inaccessible during the rains. The significance of these results is discussed.

Shute (G. T.). **A Method of maintaining Colonies of East African Strains of** *Anopheles gambiae*.—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 92–94, 2 refs. Liverpool, 1956.

Insectary colonies of *Anopheles gambiae* Giles from Kenya and two areas in Tanganyika have been established and maintained by the method described. The fertilisation rate was originally less than 10 per cent., but has been increased to 80 per cent. by keeping the adults in continuous darkness. They are kept in batches of 300–400 in cages measuring 1 × 1 × 1 ft. The females are fed on man and the males on 10 per cent. sugar solution. A petri dish lined with moist filter paper is provided for oviposition. The larvae are reared in enamel dishes measuring 10 × 12 ins. and containing distilled water, 1½ ins. deep, kept at 24–26°C. [75·2–78·8°F.]. The eggs are floated in one of these dishes for hatching, and the larvae are separated into batches of 100–150 after 48 hours. They are fed on dried yeast tablets ground with distilled water at 1 g. per 100 cc. The yeast-water mixture must be prepared immediately before use and the tablets kept quite dry to prevent fermentation. The mixture is added to the rearing water at the rate of 2 cc. per dish when the larvae hatch, 10 cc. when they are separated and 5 cc. daily thereafter. The pupae are put in small bowls in empty or stocked cages. If the cages are stocked, the bowls are covered with a truncated paper cone to prevent females from ovipositing in them. Under these conditions, the egg, larval and pupal stages last 36 hours, 7–8 days and about 36 hours, respectively.

Kershaw (W. E.), Deegan (T.), Moore (P. J.) & Williams (P.). **Studies on the Intake of Microfilariae by their Insect Vectors, their Survival, and their Effect on the Survival of their Vectors. VIII. The Size and Pattern of the Blood-meals taken in by Groups of** *Chrysops silacea* **and** *C. dimidiata* **when feeding to Repletion in natural Conditions on a Rubber Estate in the Niger Delta.**—*Ann. trop. Med. Parasit.* **50** no. 1 pp. 95–99, 4 refs. Liverpool, 1956.

It has been shown in earlier papers of this series that a group of *Chrysops silacea* Aust. feeding to repletion on a subject infected with *Loa loa* takes in about half as many microfilariae as would be expected from the size of the blood-meal and the concentration of microfilariae in the blood of the host [*R.A.E.*, B **44** 180], and that the number of infective forms found in flies that survive long enough for the infective stage to be reached is similar to the number of microfilariae ingested [**44** 8]. It is proposed to compare, in further papers, populations of microfilariae in man and in *Chrysops* in villages in the rain forest of the British Cameroons and in a rubber estate at Sapele in Southern Nigeria. The comparison will be based on data obtained in preliminary quantitative surveys undertaken in an attempt to distinguish between the contributions made by man and monkeys to the infection found in wild *Chrysops* in the two areas. These surveys included observations on the incidence and intensity of infection in the human host and of infection with the different developmental stages of the parasite in the vector. To interpret the results, it was necessary to estimate the size of the blood-meal taken in by a group of *Chrysops*. Accordingly, the size and the pattern of the blood-meal taken in by groups of *C. silacea* and *C. dimidiata* Wulp, allowed to feed to repletion on African volunteers under natural conditions in the rubber estate in 1955 were determined by measuring the amount of haemoglobin ingested, and the results compared with similar observations made on *C. silacea* in the laboratory at Kumba, in the British Cameroons, in 1952 and 1953 by direct weighing. The weights of unfed flies in the two areas and the sizes of the blood-meals ingested by flies feeding in the laboratory or under different conditions, at different times and on different individuals in the field had means and variations so related that the population of *Chrysops* was shown to form a biological entity, with reliable and normal characteristics by which its properties could be measured. The weight of the blood-meal taken in by groups of *C. silacea* and *C. dimidiata* under natural conditions at Sapele and by *C. silacea* under laboratory conditions at Kumba was found to be twice the weight of similar groups of unfed flies coming to bite.

Kenaga (E. E.). **Some biological, chemical and physical Properties of Sulfuryl Fluoride as an insecticidal Fumigant.**—*J. econ. Ent.* **50** no. 1 pp. 1–6, 1 graph, 6 refs. Menasha, Wis., 1957.

The author gives the results of laboratory investigations on the fumigant properties of sulphuryl fluoride, which are noticed in more detail elsewhere [*R.A.E.*, A **46** 88]. The compound is non-inflammable, colourless and odourless and boils at −55·2°C. It is stable in air and had no adverse effect on a variety of materials exposed to a dosage of 3 lb. per 1,000 cu. ft. for 16 hours at 80°F.

One or more stages of 14 species of insects were exposed to sulphuryl fluoride for 16 hours at 80°F., and the doses in oz. per 1,000 cu. ft. necessary to give 95 per cent. kill ranged from 4·81 to 42·7 for eggs, but were always less than 4 for other stages. They were 0·59 and 25·8 for adults and eggs of *Periplaneta americana* (L.), 1·16 for adults of *Blattella germanica* (L.) and 0·96 and 1·36 for adults and pupae of *Musca domestica* L.

Moorefield (H. H.) & Kearns (C. W.). **Levels of DDT-Dehydrochlorinase during Metamorphosis of the Resistant House Fly.**—*J. econ. Ent.* **50** no. 1 pp. 11–13, 1 graph, 12 refs. Menasha, Wis., 1957.

The studies described were carried out to determine whether DDT-dehydrochlorinase, the enzyme concerned in the detoxification of DDT in resistant house-flies (*Musca domestica* L.) [*R.A.E.*, B **45** 29] by its dehydrochlorination to DDE (1,1-bis(p-chlorophenyl)-2,2-dichloroethylene), is present throughout the life-cycle of flies of DDT-resistant strains, and to trace it quantitatively through the various stages. Amounts of the enzyme present were estimated by measuring the amount of DDT dehydrochlorinated when homogenates of 200 eggs, larvae, pupae or flies ground in 20 ml. cold, distilled water (the insoluble parts being removed) were allowed to react for 90 minutes with DDT crystallised on glass beads. Significant amounts of DDE were not produced by homogenates of eggs or of larvae 24 hours old.

Whether the enzyme is absent in these stages or merely undetectable by the method used was not established. The amounts rose rapidly with the age of the larvae to a maximum at the end of the larval period but fell, sometimes by as much as half, at the time of pupation. The level then established was maintained throughout pupal and adult life. A fall in resistance to DDT at the onset of pupation has been recorded in *Diataraxia oleracea* (L.) [A **43** 88]. The similarity of the process in the two species could be explained by postulating the existence of a major site of detoxification in the tissues that undergo early histolysis. Protein-free diets or those supplemented with milk did not significantly affect the level of DDT-dehydrochlorinase in the adult flies. Assays on fractions of populations of resistant flies selected at the time of pupation or adult emergence indicated that individuals transforming earlier contained less DDT-dehydrochlorinase than those transforming later.

SCHOOF (H. F.) & KILPATRICK (J. W.). **House Fly Control with Parathion and Diazinon impregnated Cords in Dairy Barns and Dining Halls.**—*J. econ. Ent.* **50** no. 1 pp. 24–27, 4 figs., 6 refs. Menasha, Wis., 1957.

In further tests in Georgia in 1955 of vertical lengths of cotton cord impregnated with solutions of parathion or diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] in xylene and installed at 30 linear ft. per 100 sq. ft. floor space for the control of house-flies [*Musca domestica* L.] [*cf.* *R.A.E.*, B **44** 126–127], cord 3/32 inch in diameter impregnated in 10 per cent. parathion to give about 100 mg. parathion per ft. provided satisfactory to excellent control (10–20 or 1–10 flies per grill [**38** 158]) in dairy barns and in a military dining hall. Cotton cords of the same diameter impregnated in 25 per cent. diazinon to give an estimated dosage of 150 mg. toxicant per ft. provided 6–8 weeks of excellent to satisfactory control in a military dining hall but then deteriorated. Similarly treated cords, 3/16 inch in diameter, which bore 600 mg. diazinon per ft. gave excellent control in a dairy for an entire season from May to the middle of October. Their removal from the dairy in August caused the numbers of flies to rise from six to 133 per grill count in four weeks. Subsequent reinstallation of the same cords reduced the indices to below four flies per grill for the remainder of the season. Impregnating the thicker cord with 25 per cent. diazinon costs five times as much as impregnating the thinner cord with 10 per cent. parathion, but when labour for installation is taken into consideration, the diazinon cord costs only twice as much as the parathion. Diazinon is preferable because of its low toxicity to mammals.

KILPATRICK (J. W.) & SCHOOF (H. F.). **House Fly Control in Dairy Barns with residual Treatments of Phosphorus Compounds.**—*J. econ. Ent.* **50** no. 1 pp. 36–39, 7 refs. Menasha, Wis., 1957.

Field tests were made in Georgia in 1954 and 1955 of the effectiveness of deposits from sprays of six phosphorus compounds applied in dairy barns against house-flies (*Musca domestica* L.) resistant to several other insecticides. The compounds tested were Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate] and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] as emulsions and suspensions, and Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] as a water solution, all at dosages of 100 mg. toxicant with the addition of 250 mg. sugar per sq. ft., malathion as an emulsion and a suspension at 200 mg. toxicant with 500 mg. sugar per sq. ft., and Bayer

21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate] as an emulsion at 50 mg. per sq. ft. alone and in combination with 50 mg. DDT. Effectiveness was assessed by use of a grill [*R.A.E.*, B **38** 158], counts of 1–10 and 10–20 being regarded as excellent and satisfactory, respectively.

There was no evidence that the type of formulation (emulsion or suspension) affected the results. Malathion gave satisfactory control for eight weeks in both years in one of the two dairies in which it was used, but was much less effective in the other one. Chlorthion and Am. Cyanamid 4124 provided excellent control for 7–8 weeks in 1954 and satisfactory control for about as long in 1955. Diazinon, tested only in 1954, gave 9–11 weeks of satisfactory control. Unfavourable weather conditions for house-fly breeding late in 1954 were responsible for prolonged excellent control obtained in that year. However, Bayer 21/199 did not provide satisfactory control either alone or in combination with DDT in 1954. A single application of L 13/59 in 1955 gave satisfactory control for seven weeks. Spot treatment of preferred resting places to the extent of about half normal coverage with Am. Cyanamid 4124 in 1955 resulted in poor control at one dairy and five weeks of satisfactory control at another.

Rodriguez jr. (J. L.) & Riehl (L. A.). **Malathion Spray for Fowl Tick Control.**—*J. econ. Ent.* **50** no. 1 pp. 41–43, 9 refs. Menasha, Wis., 1957.

Aqueous sprays of malathion, prepared from a 57 per cent. emulsifiable liquid formulation to give concentrations of 1, 0·5 and 0·25 per cent., were tested for the control of *Argas persicus* (Oken), on laying hens on a small poultry farm in southern California in 1955. The sprays were applied by power-driven equipment, under high pressure, to the inside and outside structural parts of the hen houses and to the litter on the floor. Particular attention was given to wetting such areas as those behind wall boards and timbers, under joists, studs and roofing material, and in cracks. Hens, eggs, and food and water containers were removed before the spray was applied and not returned until the sprayed buildings were completely dry. The population of *A. persicus* decreased progressively after application of the spray containing 1 per cent. actual malathion, and control was complete by the 49th day. The lower concentrations gave good initial kill but failed to effect complete control with one application.

Gilbert (I. H.). **Evaluation of Repellents against Mosquitoes and Deer Flies in Oregon.**—*J. econ. Ent.* **50** no. 1 pp. 46–48, 3 refs. Menasha, Wis., 1957.

Field studies with repellents and repellent mixtures were carried out in Oregon in the summer of 1955 against mixed populations of mosquitos breeding in snow water (principally *Aëdes communis* (Deg.)), mixed populations of mosquitos breeding in irrigation water (principally *A. dorsalis* (Mg.)) and deer flies (*Chrysops discalis* Will.). Repellents tested on the skin were applied as 50 per cent. ethanol solutions against irrigation-water mosquitos and 25 per cent. solutions against snow-water mosquitos and *Chrysops*, and diethyltoluamide (technical mixture containing about 72 per cent. meta isomer) was also tested in two pressurised-spray formulations against the irrigation-water mosquitos. The repellents were applied at the rate of 1 ml. solution, or an amount of spray to give the same deposit of actual repellent, to the forearm from the wrist to the elbow. Each repellent was tested against every other in a given series and an adjusted average protection period calculated for it. The standard was a 4:3:3 mixture of dimethyl phthalate, dimethyl carbate and ethyl hexanediol, which gave protection for nearly 3½ hours against mosquitos and for about half that time against *Chrysops*.

Diethyltoluamide was the most effective of the 12 individual repellents tested against irrigation-water mosquitos and the eight of them tested against snow-water mosquitos. It was about twice as effective as the standard. N,N,o-triethylbenzamide was nearly twice as effective as the standard against snow-water mosquitos. Against irrigation-water mosquitos, the ortho and meta isomers of N,N-diethyltoluamide were 145 per cent. as effective as the standard, whereas the para isomer was only 84 per cent. as effective. The six new mixtures tested all gave longer protection than the standard against both groups of mosquitos, but the differences were not so pronounced against the irrigation-water as against the snow-water mosquitos. The mixtures that contained diethyltoluamide were more effective than those that did not, and no mixture showed a higher effectiveness as compared with the standard than diethyltoluamide alone. None of the repellents or repellent mixtures differed markedly from the standard against *Chrysops*. The pressurised sprays of diethyltoluamide were almost equal to the ethanol solutions in effectiveness as skin applications. The two pressurised spray formulations, six individual repellents and 15 or 16 mixtures were tested as clothing treatments on cotton stockings, to which the repellents and mixtures were applied in acetone solution at 2 and 2·3–3·6 g., respectively, per sq. ft. All, except two of the individual repellents, gave almost complete protection from mosquitos after 26 days of ageing. All were ineffective after two rinses.

Rodriguez jr. (J. L.) & Riehl (L. A.). **Control of the Chicken Body Louse on Hens by Self-treatment with Malathion Dust.**—*J. econ. Ent.* **50** no. 1 pp. 64–67, 13 refs. Menasha, Wis., 1957.

In tests in 1955 on the control of *Menacanthus stramineus* (Nitzsch) on hens in southern California, single manual applications of dusts containing malathion were made to the whole surface of the floor litter in the fowl pens or to the corners of the pen, wallows (areas chosen by the fowls to dust themselves) or specially made dust-bath boxes, and the fowls distributed the insecticide over themselves during natural dusting activities. Applications to the whole surface were made in pens containing about 350 hens each and were at rates of 1 lb. 1 per cent. dust per 75 sq. ft. or 1 lb. 2 per cent. dust or 0·5 or 1 lb. 4 per cent. dust per 20 sq. ft. The other applications were in pens containing about 250 hens and the rates of application per pen were 10 lb. 1 per cent. dust to corners, 10 lb. 2, 4 or 10 per cent. dust to wallows, and 1 lb. 1, 4 or 10 per cent. dust per box to three dust-bath boxes measuring 3 × 2 ft. and containing 3–4 ins. fine dry litter. Hens were left in the pens during application of the dust in all cases, but food and water troughs and eggs were removed, except when boxes were being treated. The results demonstrated the high degree of effectiveness of malathion against *M. stramineus* and the practicability of the method of application. No infestations were found within 70 days of treatment of the whole litter surface at any except the lowest rate, or within more than 44 days of any treatment of wallows only. In either case, the minimum effective dosage was equivalent to 4 lb. 2 per cent. dust per 100 hens. Treatment of the corners only with 1 per cent. dust reduced infestation very considerably. When dust-bath boxes were used, control for at least 35 days was obtained with the 4 and 10 per cent. dusts, provided that an interval had first been allowed to elapse for the hens to get used to the boxes.

MENN (J. J.), BENJAMINI (E.) & HOSKINS (W. M.). **The Effects of Temperature and Stage of Life Cycle upon the Toxicity and Metabolism of DDT in the House Fly.**—*J. econ. Ent.* **50** no. 1 pp. 67–74, 2 figs., 25 refs. Menasha, Wis., 1957.

The following is mainly based on the authors' summary. The metabolism of DDT to DDE [1,1-bis(p-chlorophenyl)-2,2-dichloroethylene] and the retention of unchanged DDT were studied quantitatively in larvae and adults of two strains of house-flies (*Musca domestica* L.) of which one (S) was normally susceptible to DDT and the other (B) was highly resistant. Inclusion of 25 parts DDT per million in the diet of S larvae resulted in the presence of 0·06 μg. each of DDT and DDE per individual in the adults and 30 per cent. mortality among them soon after emergence. The same amount in the diet of B larvae resulted in 0·01 μg. DDT and 0·1 μg. DDE in the adults and no mortality. When the concentration of DDT in the diet was 2,000 p.p.m., all S larvae were killed, while the B larvae contained 1·16 μg. DDT, which decreased to 0·01 μg. in the adults. DDE was 9·1 μg. in the B larvae, decreasing to 3·5 μg. in the adults, and there was 30 per cent. mortality among the latter, probably due to a synergistic effect of the DDE with the small amount of DDT [*cf. R.A.E.*, B **42** 74].

LD50's for flies exposed for one hour to DDT as a deposit in oil in small vials at 15, 25 and 35°C. [59, 77 and 95°F.] and subsequently kept at the same temperatures were estimated to be 0·052, 0·112 and 0·252 μg. for the S flies, and 1·60, 3·84 and 7·8 μg. for the B flies. The temperature coefficients calculated from these values are all negative and vary from 2 to 2·4. The S flies were quickly affected by DDT at 15°C., and mortality was the same whether they were kept for 24 hours at 15° or for six hours at 15° and 18 hours at 25°C. B flies were affected slowly at 15° and consequently keeping them at 15° for six hours and at 25° for 18 hours resulted in the same mortality as when they were kept throughout at 25°C. Keeping flies for 12 hours at each temperature gave a mortality intermediate between those for the two temperatures with the B strain, but removal to 25° after maintenance at 15° for 24 hours was not followed by any further mortality. Thus, a few hours at 15° determines the final mortality of S flies but at least 12 hours at 15° are needed to have even a slight influence upon the final mortality of B flies. Conversely, 12 hours at 35° had no effect on final mortality with S flies but strongly reduced that of B flies. Therefore, the increase in mortality after short exposures to DDT due to lower temperatures such as may prevail at night is greater for susceptible than for resistant flies.

The absorption of DDT from oil solution by B flies increased as the temperature rose, but it was less influenced than was absorption from dry deposits from acetone solution [*cf.* A **40** 346; B **41** 176]. The initial differences in total absorption at 35° and at 25° disappeared within 24 hours, and total absorption by 48 hours was the same at 35°, 25° or 15°C. The absorbed but unaltered DDT in S flies exposed to oil solutions at 35° was high within two hours and very slowly decreased with time. The unaltered DDT in B flies similarly exposed at 35° or 25° was much lower and remained practically unchanged for 48 hours. The rate of DDT metabolism was especially important in the first few hours. The percentages of absorbed DDT metabolised at 35°C. by the S (and B) flies were 3·6 (48) in one hour, 15 (67) in two hours and 23 (74) in four hours. The high percentages in the B flies disprove the suggestion that metabolism is too slow to affect mortality. Calculation by time intervals shows that, after a few hours, the temperature coefficient (for 35/15°C.) of DDT metabolism steadily increased while that of absorption decreased. Thus if an insect lived for a few hours at the higher temperature, it had an increasing chance of surviving. Survival is favoured by increased temperature whenever conditions of exposure are such that the rate of detoxification or excretion soon exceeds that of intake. This situation is typical of single exposures unless they are so massive that the insect dies within a few hours. Such heavy doses always have a positive temperature coefficient of mortality. The log-probit dosage-mortality lines for either strain of flies were parallel at the three temperatures. This indicates that temperature does not affect the degree of heterogeneity of the strains in their reaction to DDT. The B strain had much flatter lines than the S strain and hence was more heterogeneous in its response.

O'Brien (R. D.). **The Effect of Malathion and its Isomer on Carbohydrate Metabolism of the Mouse, Cockroach and House Fly.**—*J. econ. Ent.* **50** no. 1 pp. 79–84, 2 figs., 20 refs. Menasha, Wis., 1957.

As it had been shown [*R.A.E.*, B **45** 142–143] that malathion (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorodithioate) may exercise its toxic effect on insects by some property other than anticholinesterase activity, and that succinoxidase inhibition is apparently not involved, the effects of malathion and isomalathion (O,S-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorodithiolate) [*cf. loc. cit.*] on some enzymes involved in carbohydrate metabolism were studied in mouse brain, in the muscle tissue of the American cockroach (*Periplaneta americana* (L.)) and in whole house-flies (*Musca domestica* L.). Isomalathion was included because its behaviour may be similar to that of "malaoxon" (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorothiolate), which is probably a primary metabolic product of malathion metabolism in insects and mammals, and may entirely account for the toxic effect of malathion on them [**45** 77].

The following is based on the author's summary of the results. Malathion and isomalathion had quite a strong inhibitory effect on pyruvate oxidation in mouse brain, perhaps through interference with the citrate oxidising system. Apart from this, they did not substantially inhibit the glycolytic and tricarboxylic acid cycle pathways of carbohydrate metabolism in mouse brain or tissue of the cockroach (or house-fly where observations were possible). Furthermore, the results showed generally smaller inhibitions for insect than for mouse enzymes. Since malathion is far more toxic to insects than to mammals, it is unlikely that the interferences with carbohydrate metabolism have any connection with the insecticidal action of the compound.

Blum (M. S.) & Bower (F. A.). **The Evaluation of Triethyl Tin Hydroxide and its Esters as Insecticides.**—*J. econ. Ent.* **50** no. 1 pp. 84–86, 10 refs. Menasha, Wis., 1957..

Triethyl tin hydroxide having been found to be highly toxic to house-flies [*Musca domestica* L.], six esters of triethyl tin were prepared by the reaction of the hydroxide and the desired acid or its anhydride, and a study was made of their toxicity to house-flies of a DDT-resistant and a normally susceptible strain. One example each of the techniques of preparing esters from liquid and solid acids is given, and the properties of the six esters are summarised in a table. The compounds were evaluated by topical application of 1 µl. of a dilute (0·01–0·2 per cent.) solution in redistilled acetone to each of 20 lightly anaesthetised flies, which were kept for 24 hours at 30°C. [86°F.] with a suspension of powdered milk supplied, before mortality counts were made. All were toxic at very low dosages, the LD50's in µg. per fly of the resistant and (in brackets) susceptible strains being 0·4 (0·31) for the hydroxide, 0·45 (0·25) for the formate, 0·54 (0·3) for the acetate, 0·7 (0·42) for the acrylate, 0·74 (0·52) for the benzoate, 0·93 (0·51) for the *d-trans* chrysanthemate and 1·28 (0·76) for the bis(p-chlorophenyl)acetate, but as none of the esters was more toxic than the hydroxide and their toxicity decreased with increasing molecular weight, it would appear that the toxic moiety is the triethyl tin portion of the molecule. All the compounds rapidly induced paralysis in the flies. The esters did not inhibit cholinesterase effectively, but completely blocked conduction in the isolated nerve cord of *Periplaneta americana* (L.).

BANN (J. M.), DECINO (T. J.), EARLE (N. W.) & SUN (Yun-pei). **The Fate of Aldrin and Dieldrin in the Animal Body.**—*J. agric. Fd Chem.* **4** no. 11 pp. 937–941, 28 refs. Easton Pa., 1956.

DAVICH (T. B.), TOMBES (A. S.) & CARTER (R. H.). **Insecticide Control of Green June Beetle Larvae attacking Ladino Clover Pastures: Residues on Foliage and Accumulation in Swine Tissue.**—*J. econ. Ent.* **50** no. 1 pp. 96–100, 5 refs. Menasha, Wis., 1957.

In the first of these papers, the authors review the literature on the fate of chlorinated insecticides in the body of mammals and point out that heptachlor has been found to be oxidised to heptachlor epoxide in animals and stored as such. Studies on the fate of aldrin and dieldrin were begun because tests by bioassay techniques [*R.A.E.*, B **40** 104; **42** 144] indicated the presence of larger quantities of toxicant in the milk of cows and the fat of rats that had been fed with aldrin than did a phenyl-azide colorimetric method of analysis, specific to aldrin, from which it was concluded that the aldrin had undergone a structural change within the animals, possibly (on analogy with heptachlor) to dieldrin. Subsequent comparison of the results obtained by these methods, analyses for total organic chlorine and analyses by a colorimetric method specific to dieldrin showed that butter from cows fed with aldrin, the fat of beef cattle and sheep into which aldrin had been injected subcutaneously, the fat of pigs that had been fed on hay treated with aldrin, and eggs from hens fed with aldrin all contained dieldrin, and this conclusion was supported by the infrared spectra. Some also contained very small quantities of aldrin, and the sum of the amounts found by the methods specific to aldrin and to dieldrin approximated to the total found by bioassay, indicating that no unidentified toxic compound was present in significant quantities. Epoxidation of aldrin to dieldrin in the body apparently takes place readily, as dieldrin was found in the milk of cows within 24 hours after they had ingested aldrin. Analysis for dieldrin, by all available methods, of butter from cows fed with dieldrin and of fat from beef cattle that had received a subcutaneous injection of it yielded results that were in good agreement, indicating that dieldrin accounted for all the toxicity in the samples and is stored unchanged in the animal body.

The experiments described in the second paper are noticed elsewhere [*R.A.E.*, A **46** 99], but include the results of analysis of the fat of young pigs slaughtered after they had been allowed to graze on pastures that had been treated with aldrin in granules. In 1953, they were kept for 76 days on pastures that had been treated with 1·9–14·8 lb. aldrin per acre. Specific analysis of the fat back for aldrin showed none, whereas its specific analysis for dieldrin, bioassay, and analysis based on total organic chlorine showed 0·2–1·82, 0·4–2·7 and 2–2·2 parts per million, respectively. In 1954, no aldrin or dieldrin was found by specific analyses in the subcutaneous fat of pigs that grazed for 119–133 days on pasture treated with 4 lb. aldrin per acre, though 0·4–0·5 p.p.m. was indicated by the organic-chlorine method.

PATTERSON (R. S.). **On the Causes of broken Wings of the House Fly.**—*J. econ. Ent.* **50** no. 1 pp. 104–105, 1 fig., 3 refs. Menasha, Wis., 1957.

The occurrence of broken wings among caged house-flies (*Musca domestica* L.) has often been noted. The damage is largely confined to males. Sometimes 50–75 per cent. of the males in a culture two weeks old have the wings torn to some degree. Observations on flies confined in cages too small to allow of mating and on flies confined in groups of one sex, which attempted to copulate with individuals of their own sex and were repulsed, together with negative observations on the effect of overcrowding and changes in diet, confirmed the theory that the tearing is caused by thrusts of the metathoracic legs of females resisting mating attempts. Females in the laboratory appear to be fertilised twice, about three and 7–10 days after they emerge. Further advances by the males are resisted. Males with torn wings are found in the field as well as in the laboratory.

BARKER (R. J.) & ABD-EL-RAHMAN RAWHY. **Toxicity of DDT in Acetone and in Oil to Adult House Flies.**—*J. econ. Ent.* **50** no. 1 p. 105, 4 refs. Menasha, Wis., 1957.

A comparison was made of the toxicity of DDT topically applied in acetone and in petroleum oil to house-flies (*Musca domestica* L.) of a normally susceptible strain, and of its absorption in flies of a highly resistant strain [*cf. R.A.E.*, B **41** 122]. The flies were treated by application of 1·23 µl. solution to the pronotum, and kept for 24 hours at 25·5°C. [77·9°F.] and 30 per cent. relative humidity with sugar-water provided. They were then examined for mortality or absorbed insecticide. The results showed that, under the conditions of the experiment, topically applied DDT was 4·2 times as toxic to the normal flies in acetone as in petroleum oil at the LD50 level. The dosage-response curves were not parallel. Resistant flies were treated with 0·8 µg. DDT. This dosage caused 21·2 per cent. mortality in oil and 1·7 per cent. mortality in acetone. Oil alone was not toxic, and the flies that died after receiving DDT in oil showed typical DDT tremors, though the strain is usually unaffected by DDT. More DDT was absorbed from the acetone solution (74·1 ± 14·6 per cent.) than from the oil (40·7 ± 11·9 per cent.), but such a difference in absorption seemed insufficient to explain the difference in the LD50's of the susceptible flies.

JONES (R. H.). **The Laboratory Colonization of** *Culicoides variipennis* **(Coq.).**—*J. econ. Ent.* **50** no. 1 pp. 107–108, 2 refs. Menasha, Wis., 1957.

Evidence that *Culicoides variipennis* (Coq.) is involved in the transmission of blue-tongue of sheep in the south-western United States [*R.A.E.*, B **42** 147] made its colonisation in the laboratory desirable, so that its control and vector ability could be adequately studied. This was therefore attempted at Kerrville, Texas, and two colonies were successfully established. The adults are kept in cartons with transparent plastic covers. Ventilation is provided by a hole in the plastic, covered with nylon cloth, and access by another hole closed with a cork. Cartons of ½ U.S. pint capacity hold up to 400 adults and those of 1 U.S. gal. capacity several thousand. Saturated cotton and water in a pill-box fitting into a hole in the bottom of the carton are provided.

as well as split raisins as food for the males, and the females are given blood-meals on the ears of a rabbit. The ear is exposed to the midges in a small plastic cylinder, and the maximum number of adults, including males, that should be put in the cylinder at one time is about 500. As many females need more than one blood-meal to produce eggs, opportunity to feed should be provided for the colony every day. The maximum length of life recorded in an adult female was 37 days in one that took nine blood-meals. Blood-feeding and pairing begin about one day after adult emergence. Pairing has to be stimulated by the periodical confinement of the adults in the feeding cylinder or a smaller container to bring them into contact. The eggs are laid on the dish of water, and a piece of absorbent paper placed on the surface facilitates their removal. Individual females laid as many as 491 eggs at one time and 675 in all. The larvae are reared in shallow white enamelled pans in a medium consisting of one part fresh cow dung, two parts soil and enough water to form a thick mud that can be evenly distributed in the pan. The medium is inclined in the pan so that about half of the surface can be kept under shallow water. As the pupae will float on water, they are removed from the pans by flooding; they are then put in a pill-box, which is inserted into the bottom of a holding cage for emergence. The egg, larval and pupal stages and preoviposition period last about 2, 23, 2 and 3 days, respectively, at 75°F. and 50 per cent. relative humidity, and survival through the egg and larval stages ranges up to 85 per cent. At 85°F. and 100 per cent. relative humidity, the larval stage was completed in 7–12 days, but the adults obtained were much smaller, larval mortality was higher and it was more difficult to keep the medium in good condition.

Wallis (R. C.) & DeBishop (R. J.). **Death-stress Oviposition by** ***Aedes canadensis.*****—***J. econ. Ent.* **50** no. 1 p. 112, 3 refs. Menasha, Wis., 1957.

DeCoursey & Webster showed that females of *Aëdes sollicitans* (Wlk.) could be stimulated to oviposit by a " death stress " and suggested that this might aid control by encouraging oviposition under conditions unfavourable for egg development [*R.A.E.*, B **41** 105]. Evidence that *A. canadensis* (Theo.), the most common pest mosquito in Connecticut during the spring and summer, would also oviposit under death stress was obtained during observations on females collected in 1956. Those that contained fresh blood were isolated in test tubes containing water and moist filter paper and stoppered with cotton moistened with 5 per cent. sucrose solution. All the other females were kept over water in lantern-chimney cages and fed on sucrose solution for four weeks. At the end of this time, they were knocked down with cigarette smoke and transferred to vials that were sealed for freezing one hour later. Of 36 engorged and isolated females, one laid 24 eggs and died eight days later, 12 others delayed oviposition until just before death, and 22 died before eggs had developed. The 219 unfed females showed no sign of oviposition activity until the cigarette smoke provided a death stress. In the hour between exposure to smoke and freezing, 32 females oviposited and died. The average number of eggs per female laid by them was 38.

Roth (A. R.). **Cattle Grubs found in the Gullets of Oregon Cattle.**—*J. econ. Ent.* **50** no. 1 p. 115, 4 refs. Menasha, Wis., 1957.

Little is known about the season of occurrence and course of development of larvae of *Hypoderma lineatum* (Vill.) in the gullets of cattle before they migrate to the back [*cf. R.A.E.*, B **31** 15, 174; **40** 199]. For a year beginning in September 1954, the author collected cattle gullets in Oregon, usually twice a month, and examined them for the presence of *H. lineatum*. In all, 558 gullets were obtained and examined. No larvae were found in 196 obtained in March–June, and the percentage of gullets infested and the number and size of the larvae in them rose steadily from July to September. In September, October and December 1954 and January and February 1955, 25·4, 59, 35·5, 30 and 2·3 per cent. of gullets examined were infested, the average numbers of larvae per gullet were 2·5, 4·9, 3·7, 1·1 and 0·3 and the average lengths of the larvae in mm. were 6·6, 8·3, 12·3, 13·6 and 13, respectively. Thus, the larvae concentrate in the gullets 2–4 months after they enter the hosts and reach maximum development in December or January. Encystment in the backs usually starts at the beginning of January.

HANEC (W.). **Investigations concerning Overwintering of House Flies in Manitoba.**—*Canad. Ent.* **88** no. 8 pp. 516–519, 6 refs. Ottawa, 1956.

The manner in which house-flies [*Musca domestica* L.] survive the winter in Manitoba was investigated during 1953–54 and 1954–55. In both winters, the flies bred continuously in a heated barn in which pigs were kept and the temperature ranged from about 55 to 70°F. Larvae were found in vacant feeding troughs containing the remains of pig feed, between the troughs and the wall where feed and dung had been scattered, under the troughs, and in dung on the floor, and pupae occurred mostly in dry dung and straw under the feeding troughs. Both stages developed at temperatures of 48–90°F. Adults tended to concentrate in the centre of the barn, which was warmer than elsewhere and free from draughts, and were particularly attracted to pens containing suckling pigs. During the winter of 1954–55, two unheated barns, one housing about 90 cattle and the other about 300 pigs, were inspected periodically for adult flies. Both had been heavily infested in autumn and the temperatures in them ranged from about 50°F. by day to about 70°F. at night. The flies were active in them until the end of December, but none was seen in January or February. The barns were then very damp and this may have inhibited flight. They were visited again at the end of April, following a warm fortnight during which the mean maximum and minimum temperatures were 56·7 and 38°F., and many flies were active in them. Since it was too cold for long-range flight, these flies had either hibernated in the barns, which, owing to the dampness and prevalence of fungus attack, was unlikely, or had been produced by continuous breeding.

The ability of the eggs, larvae and pupae to resist moderate cold was investigated by keeping them at 40°F. The percentages of eggs that hatched at 80°F. after having been kept at 40° for two, three, four and five days were 85, 57, 2·7 and 0, respectively. Some newly hatched and full-grown larvae survived for nine and 23 days, respectively, and subsequently pupated at room temperature; others of all ages kept in the cold room for a week became discoloured and died as soon as they were transferred to the warm air. Some full-grown larvae pupated in the cold room, but the pupae were abnormal and no adults emerged from them. The pupae were the most resistant stage; the percentages that gave rise to adults at 75°F. after exposure at 40° for 15, 30, 45 and 51 days were 26·6, 3, 1 and 0. Adults did not emerge at 40°F., and were often unable to emerge completely from pupae transferred to room temperature towards the end of the survival period; many that did succeed died in a few hours, though provided with food and water.

Bradbury (F. R.). **Absorption and Metabolism of BHC in susceptible and resistant Houseflies.**—*J. Sci. Fd Agric.* **8** no. 2 pp. 90–96, 2 figs., 18 refs. London, 1957.

An account is given of experiments on the absorption and metabolism of BHC isomers in house-flies (*Musca domestica* L.) of a strain normally susceptible to γ BHC and a strain resistant to it. The flies were exposed at 25°C. [77°F.] to vapours of the isomers labelled with ^{36}Cl or ^{14}C, and radioactive material was recovered from the treated flies by extraction with carbon tetrachloride and with water. It was shown by quantitative investigations, described in detail in an earlier paper [*R.A.E.*, B **45** 30], that all the four common isomers (α, β, γ and δ) are metabolised to water-soluble compounds by both susceptible and resistant flies, but that the resistant flies absorb less and metabolise a greater proportion of the amount absorbed. The α and γ isomers were converted to water-soluble products more readily than the other two.

Chromatography of the carbon-tetrachloride extracts of flies treated with γ and δ BHC indicated that they consisted mostly of unchanged BHC. Of two likely dehydrohalogenation products soluble in carbon tetrachloride, trichlorobenzene has not been demonstrated in the extracts of flies treated with γ BHC [**43** 187], and though Sternberg & Kearns have claimed that pentachlorocyclohexene is formed by resistant flies as the major initial metabolic product of γ BHC and that chromatography fails to distinguish it from the latter [**45** 145], isotopic dilution experiments by the author and Standen have indicated that the radioactivity in carbon-tetrachloride extracts of resistant flies that have been exposed to γ BHC for 24 hours is largely γ BHC with little, if any, pentachlorocyclohexene. There is, however, evidence that metabolism is accompanied by dechlorination of the BHC molecule. In the cases of α, γ and δ BHC, metabolism to water-soluble products was accompanied by the production of chloride ions corresponding to the removal of 4–6 atoms of chlorine from each molecule of BHC metabolised. It is therefore considered unlikely that the metabolites are trichlorobenzene derivatives.

Chromatographic evidence indicates the ultimate production of eleven water-soluble compounds from both α and γ BHC. It is deduced from two-dimensional chromatograms and from paper electrophoresis that the two isomers produce identical or very similar series of compounds and that these are acidic. The production of structurally identical derivatives from two stereoisomers implies that the stereoisomerism is removed in the process. This could be achieved by conversion from cycloaliphatic to aromatic and would result either from dehydrohalogenation to trichlorobenzene or dechlorination to benzene. Since it is unlikely that all the metabolites are trichlorobenzene derivatives, benzene may be an intermediate stage in the production of some of them. The part played by metabolism in making an insect resistant to poisoning is discussed in terms of the effect of the product of concentration and time, and it is concluded that detoxication by metabolism is essential for the complete recovery of an insect following absorption of insecticide. Figures are given showing the extent to which α and γ BHC were metabolised to water-soluble material in susceptible insects of several species, including mosquitos [*cf.* **45** 86] and cockroaches. It is evident from them that the susceptible strain of the house-fly is in a class by itself in ability to eliminate γ BHC as water-soluble products. It is thought that the existence in normal house-flies of a metabolic way of dealing with BHC predisposes the species to the acquisition of resistance.

LOFGREN (C.), BURDEN (G. S.) & CLARK (P. H.). **Experiments with Insecticides for the Control of German Roaches.**—*Pest Control* **25** no. 7 pp. 9–10, 12, 47, 7 refs. Painesville, Ohio, 1957.

Experiments designed to find insecticides that could be used for the control of *Blattella germanica* (L.) instead of those to which the cockroach has become resistant [*R.A.E.*, B **46** 33, etc.] were carried out in Florida in 1956. The extent of resistance to chlordane in an area not receiving regular treatment was first determined by making 28 collections of *B. germanica* in homes in sub-standard parts of Orlando in spring and summer, and exposing males or male progeny of captured females to deposits of 10 mg. per sq. ft. The times required for 50 and 90 per cent. kill (LT50 and LT90) ranged from 3·2 to 126 and 3·9 to 190 hours, the LT50 and LT90 of the normal laboratory strain being 4·1 and 5·9 hours. On the assumption that an LT50 or LT90 three times as great as normal indicated significant resistance, 12 collections showed such resistance. Nine insecticides were compared against natural infestations. These were chlordane, malathion, Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], Bayer L 13/59 (Dipterex) [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate], Dow ET-14 [O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] and Dow ET-15 [O-methyl O-2,4,5-trichlorophenyl phosphoramidothioate] as 2 per cent. oil sprays, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] as a 0·5 per cent. oil spray, and dusts of sodium fluoride and of ryania with a synergist. Sprays were applied under pressure with a fan-type nozzle and dusts with a small plunger-type duster, both as spot treatments to areas where cockroaches were hiding or would be most likely to walk. All the phosphorus insecticides greatly reduced the numbers of cockroaches, most of them maintaining 98 or 99 per cent. control over considerable periods. Diazinon and Chlorthion were a little more effective, and L 13/59 a little less effective than the other three. Control reached its maximum in 1–12 days, and decreased after 5–6 weeks. Chlordane gave 99–100 per cent. control of non-resistant cockroaches from the eighth to the 36th day and 84–93 per cent. control of slightly to highly resistant populations for 30 days. Sodium fluoride and ryania gave maximum reductions of only 62 and 41 per cent., respectively, in the number of living cockroaches seen. It is concluded that oil sprays of any of the phosphorus compounds tested will give good control, provided they are applied thoroughly. When cockroaches had been almost or completely eliminated from a home, infestation did not build up again appreciably for 2–6 months. In tests to determine the frequency of treatment necessary to maintain complete control, treated homes were examined every two weeks for 26 weeks and re-treated whenever a living cockroach was seen. Of four homes treated with diazinon, one remained uninfested throughout the observation period, one needed re-treatment after 12 weeks, one after 20 weeks and one after two and 12 weeks. Three homes infested with non-resistant cockroaches and treated with chlordane needed a second treatment after 4–6 weeks, and one of them a third application after 14 weeks. Malathion eliminated infestation in one home with a single treatment, but three applications over the first six weeks were needed in three others.

In ageing tests of the sprays, unpainted plywood panels sprayed when homes were treated were left in the kitchen for one, two, four and eight weeks, after which male cockroaches were exposed on them and the time needed to cause complete mortality was noted. The average periods of exposure in hours needed to give complete kill after the deposits had aged for one and (in brackets) four weeks were 0·7 (5) with chlordane, 1·7 (2·4) with Chlorthion, 1·8 (4) with ET-15, 3·3 (23) with L 13/59, 3·8 (53) with

ET-14, 6·6 (66) with diazinon, and >10 (75) with malathion. Corresponding figures for the first six insecticides after eight weeks were 59, >6, 9, 32, 152 and >324.

Cattle-grub Control with Systemic Insecticides.—ARS 22–37, [2+] 8 pp., 1 fig., multigraph. Washington, D. C., U.S. Dep. Agric., Agric. Res. Serv., 1957.

Various compounds tested as systemic insecticides against *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) in cattle prior to 1945 [*cf. R.A.E.*, B **43** 104, 187; **45** 7, 40] killed many of the larvae encysted in the backs, but were not effective against the younger larvae in the body and so would not prevent damage to the hides. Experiments on calves in Oregon early in 1955 having shown that Dow ET-57 (purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate) causes high mortality of larvae of both species of *Hypoderma* when they are encysted in the backs, and that the best method of treatment was oral administration in capsules at a dosage of 100 mg. per kg. body weight, the effect of this dosage on the younger larvae was investigated in a series of tests. The first of these was made in Texas, where five calves known to be infested with *H. lineatum* were treated with ET-57 in June, 2–3 months before the larvae normally appear in the backs, and five similar calves were treated with another chemical. In August–November, 98 larvae appeared in the backs of the second group and only four, all of which died before emerging, in the backs of the calves treated with ET-57. In a larger test in Oregon, cattle treated with ET-57 in December 1955 had an average of only 1·3 larvae per animal in the backs in January–May 1956, whereas untreated animals had 22·1. It is believed that ET-57 would have been even more effective if administered earlier. In a third test, cattle were treated in South Dakota on 10th February and sent with untreated ones to Texas, where the treated and untreated groups were found to have averages of 17·7 and 31·2 larvae per animal in the backs a week later. As no more larvae appeared in the backs of the treated cattle after 17th February, while an average of 34 appeared in the untreated ones, all hide damage would probably have been avoided if ET-57 had been administered soon enough. Nearly all the encysted larvae were killed. In a limited number of tests in Oregon in which ET-57 was administered by spraying, it killed only encysted larvae.

There was no indication that ET-57, administered orally at 100 mg. per kg. affected the health of the cattle or meat production. It was slightly toxic at 150 mg., but recovery was rapid. The meat of treated animals was eaten without ill effect. Two calves dosed with ^{32}P-labelled ET-57 were found to contain 50 and 7 parts per million in the fat when slaughtered after three and 14 days, respectively.

Limited tests with Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate] showed that this compound also destroys *Hypoderma* larvae before they can damage the hide of the hosts and that, unlike ET-57, it does so when applied as a spray. It is concluded that both show promise for the control of *Hypoderma* but neither can be recommended until more complete toxicological information is available.

Legg (J). **A Test of two organic Phosphorous Compounds, Diazinon and Malathion, in the Control of Cattle Tick in Queensland.**—*Aust. vet. J.* **32** no. 3 pp. 55–60, 1 ref. Sydney, 1956.

The effectiveness of sprays of diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] and malathion against *Boophilus annulatus microplus* (Can.) was tested in Queensland, on cattle on which very heavy populations of all stages of the tick had been built up by artificial infestation with several thousand larvae three times a week. The test cattle were sprayed thoroughly, generally with a hand pump at about 2–3 gals. per animal, and removed to a concrete pen for observation. Diazinon was used in an emulsion. It gave virtually complete control of ticks of the standard strain and complete control of those of a DDT-resistant strain at a concentration of 0·05 per cent. and allowed of very few survivors at 0·015–0·0375 per cent. It gave complete control of a toxaphene-resistant strain at 0·05 per cent. No harmful effects were seen on animals treated with concentrations much higher than those likely to be used in the field. The stages most susceptible to diazinon were the recently emerged adult females and the larvae, followed by females more than three days old and nymphs.

Malathion as an emulsion allowed survival of a few adults of the standard strain at 1·25 per cent. and a few nymphs and adults of the standard and DDT-resistant strains at 1 or 0·5 per cent. spray, but gave a very high degree of control even at the lowest concentrations. As a wettable-powder suspension, it gave complete control of the DDT-resistant and toxaphene-resistant strains at 0·5 per cent. It allowed some adults of the standard strain to survive at this concentration, but gave complete or virtually complete control at 0·75 or 1 per cent. Neither malathion nor diazinon gave protection for more than two days. The preparations are not stable enough to be used in dipping vats, but they should be of value where hand power-sprayers are employed or where cattle walk through a continuous spray of fluid fed by a rotary pump.

Jefferies (B. C.). **Jetting Sheep with Dieldrin.**—*J. Dep. Agric. S. Aust.* **60** no. 1 pp. 3–8, 17, 10 figs. Adelaide, 1956.

The normal programme of measures to protect sheep from infestation by blowflies in South Australia consists of cutting lambs' tails to the correct length [*cf. R.A.E.*, B **37** 1], performing Mules' operation [**32** 142] and crutching once a year. It gives adequate protection in most seasons, but when it is insufficient, jetting has been found to be a useful supplement as an emergency measure. Jetting can be used to prevent body strike during fly waves following hot, humid weather; in place of second and third crutchings, when it saves costs and loss of wool; to prevent tail strike at marking time; as a routine practice to protect rams against head, body and crutch strike; and to treat occasional strike. BHC and DDT have now been superseded for jetting by other insecticides, of which dieldrin and aldrin are the best known and have been most widely tested [*cf.* **45** 209]. When they were used at the same strength, aldrin was found to be the cheaper, but subsequent large-scale tests have shown that dieldrin can be used at one-quarter the strength of aldrin and still give longer protection. It is stated in a footnote that diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] has recently been released as an insecticide for blowfly control and is claimed to give 29 weeks' protection at normal dilutions as compared with 16 weeks for dieldrin and aldrin.

For jetting to prevent strike, dieldrin should be used at 0·025 per cent. To treat struck sheep, it should be applied at 0·05 per cent., either by jetting or swabbing, to the affected area and a 3-inch margin around it. Thus used, it kills all larvae within 24 hours, whereas with the older shearing treatment, they were left on the ground to develop and wool was lost. Moreover, the treated area serves as a trap for 3–5 months. Rams should be treated separately from the flock with 0·05 per cent. dieldrin, and particular attention should be given to the head, as well as the back and crutch. Cost and equipment and jet size and pressure are discussed. Jetting at very high pressures can cause skin damage, and it is best to use the lowest pressure that will give effective penetration of the wool, combined with rapid treatment and economy of fluid.

NEWTON (L. G.) & O'SULLIVAN (P. J.). **A Note on the Occurrence of the Mite** *Cnemidocoptes pilae* **on Budgerigars in Queensland.**—*Aust. vet. J.* **32** no. 4 pp. 89–90, 2 figs., 3 refs. Sydney, 1956.

Lesions at the base of the beak and on the eyelids, the unfeathered parts of the face and the legs of a budgerigar (*Melopsittacus undulatus*) from an aviary in Townsville, Queensland, were found to be heavily infested with *Cnemidocoptes pilae* Lavoipierre & Griffiths [*R.A.E.*, B **41** 194]. Deep and extensive scrapings from all visible lesions yielded only females and larvae, but when the carcase was shaken up in water with detergent, about 15 males were washed out. Similar lesions are often seen on budgerigars in the Townsville area, where they are known to local bird fanciers as " fungus disease ", and have recently been noted in the Brisbane area. This is believed to be the first record of the occurrence of the mite in Australia. Treatment of a few infested budgerigars with preparations of BHC and oil effected a cure, but accidental ingestion of the BHC resulted in the death of one bird.

MITCHELL (W.) & TRESADERN (F. H.). **A modified ' Pyrethrin II ' Assay.**—*J. Sci. Fd Agric.* **6** no. 8 pp. 465–467, 3 refs. London, 1955.

HODGSON (H. C.). **Paper Chromatography of the False Pyrethrins.**—*Op. cit.* **8** no. 6 pp. 347–350, 6 refs. 1957.

In current methods for determination of pyrethrin II in a pyrethrum extract, the chrysanthemic acid is removed, the residual aqueous liquid is concentrated, saturated with sodium chloride and acidified with hydrochloric acid, and the liberated acidic matter is extracted with ether. After removal of the ether, the residue is titrated with alkali, and the content of " pyrethrin II " is calculated on the assumption that the total acidic matter represents chrysanthemumdicarboxylic acid derived from the hydrolysis of true pyrethrin II and cinerin II originally present in the sample. It is shown in the first paper that this assumption is invalid, because the residue also contains acids distinguishable from chrysanthemumdicarboxylic acid by their insolubility in water, and an additional stage in the procedure, by which the water-soluble acid is removed for titration, is proposed. It is confirmed that this acid is practically pure chrysanthemumdicarboxylic acid.

The results of the experiments described in the second paper show that there are at least four of these false pyrethrin II acids (all of which probably exist in esterified form in the original pyrethrum extracts), and that the contents of false pyrethrin II in various samples of pyrethrum flowers were not correlated with their total pyrethrin contents or with the ratios of pyrethrins I to pyrethrins II.

HADDON jr. (W.). **An artificial Membrane and Apparatus for the Feeding of the Human Body Louse** *Pediculus humanus corporis.*—*Amer. J. trop. Med. Hyg.* **5** no. 2 pp. 315–325, 4 figs., 15 refs. Baltimore, Md., 1956.
The Maintenance of the Human Body Louse *Pediculus humanus corporis* **through complete Cycles of Growth by serial Feeding through artificial Membranes.**—*T. c.* pp. 326–330, 2 figs., 8 refs.

In the first paper, a method is described by which *Pediculus humanus humanus* L. (*P. h. corporis* Deg.) was successfully fed on liquids through an artificial membrane. A membrane was sought that was stable, waterproof, self-sealing, sterilisable, and capable of being penetrated by the haustellum of the louse but not by the longer claws. It was also necessary that claw-hold should be provided at distances convenient for the various instars. Gutta-percha sheet less than 25 μ thick, bonded to a superficial layer of gauze with 20 × 12 meshes to the inch, was found to fulfil the required conditions. Details are given of the method of preparing the membrane from commercially available gutta-percha sheet and of assembling and filling the feeding apparatus. The meal chambers were 0·5 mm. deep. Feeding took place at membrane surface temperatures of 32–39°C. [89·6–102·2°F.] but was most complete at about 34·4°C. [about 94°F.]. It was erratic at ambient temperatures above 30°C. [86°F.]. Behaviour of the lice on the membranes was similar to that observed on human skin. Copulation and moulting occurred normally, but oviposition was rare.

In addition to lice, all feeding stages of *Ornithodoros* spp. and *Cimex lectularius* L. and females of *Aëdes aegypti* (L.) were successfully fed by this technique.

It is reported in the second paper that two colonies of normal lice were maintained; one through two complete life-cycles and one through one and a partial second, by feeding through the artificial membranes on meals of sterile, defibrinated, haemolysed human blood, with and without the addition of 10 units each of penicillin and streptomycin per ml. The ambient temperature was maintained at 26–30°C. [78·8–86°F.]. The lice were allowed to feed for 60–70 mins. about every 12 hours for 31 or 16 days and then once a day, and were kept between feedings on cloth pads at a temperature of 30°C. and a relative humidity of 60 per cent. The experiments were begun with first-instar nymphs and the first, in which no antibiotics were used, was terminated after 48 days, when F_2 nymphs were hatching and feeding, and the second, in which antibiotics were included, after 27 days, when F_1 nymphs were feeding and developing. The results from the two experiments were practically identical. In both, the rates of oviposition, hatching and nymphal mortality and the duration of development all fell within the limits considered normal when lice are reared on the human body. The antibiotics were introduced to control contaminating bacteria that complicate microscopical examination of gut preparations. S. D. Bell jr. had observed that penicillin and streptomycin did not inhibit *Rickettsia mooseri* or *R. prowazekii* in human tissue culture when each was used at 10 units per ml. but did so at 25 units. The antibiotics at the level used had no apparent effect on the growth or development of the lice. The prepared blood remained suitable for feeding lice after storage for as long as six weeks at temperatures between −15 and −20°C. [5 and −4°F.].

Kilpatrick (J. W.) & Bogue (M. D.). **Adult Fly Production from Garbage Can Sites and Privy Pits in the Lower Rio Grande Valley.**—*Amer. J. trop. Med. Hyg.* **5** no. 2 pp. 331–339, 1 graph, 8 refs. Baltimore, Md., **1956.**

Studies on the species and numbers of flies breeding in used and abandoned privy pits and in "garbage can sites" were carried out in four towns of the lower Rio Grande Valley of Texas between October 1951 and August 1952. The prevailing temperatures in the area favoured fly breeding throughout the year. The methods used to trap the emerging flies are described. Many more flies developed from privy pits in a town in which the pits had been treated with dieldrin than from untreated pits elsewhere and the vast majority of them were *Musca domestica* L. [*cf. R.A.E.*, B **44** 30], though substantial numbers of *Sarcophaga*, *Fannia* and *Hermetia* were also taken. The darkness and depth of the pits appeared to have little effect on breeding. Treated pits were free of cockroaches and other arthropods, but the presence of suspected predators of *M. domestica* in the untreated pits, though perhaps of some significance in controlling breeding, was probably not the only factor involved, nor is the elimination of competitors of *M. domestica* by the insecticide thought to be of major importance. The heavy breeding in the treated area is thought to be more probably attributable to the linking of resistance with a physiological change in behaviour, so that dieldrin-resistant flies can use privy contents as breeding media or can survive in privies more successfully than non-resistant ones. Abandoned privy pits covered to some extent with soil produced considerable numbers of flies, but about half of those emerging were *Sarcophaga* spp. and only about 14 per cent. *M. domestica*. Furthermore, abandoned pits are thought to be too few in number to constitute an important source of flies.

" Garbage can sites " were the ground around garbage containers (which were removed for the period of trapping). A site was classed as " approved " when the container was of metal and in good condition and had a well-fitting lid, and " non-approved " when it was of some other type. There was great variation in the number of flies emerging from individual sites, and emergence continued over a considerable period. About 96 per cent. of the flies produced were *Lucilia cuprina cuprina* (Wied.) (*Phaenicia pallescens* (Shann.)). The average number of flies emerging per container was greater at the sites with approved containers than at the others. It is concluded that the method of preparing the garbage to be put in the container and the proper maintenance and covering of the latter are all of importance in preventing flies from breeding in it.

Yu (En-shu), Lin (She-gin) & Ch'en (Chin-liang). **Natural Infection of the domestic Rabbits with** *Rickettsia tsutsugamushi* **in Fukien.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 2 pp. 183–188, 8 refs. [Peking] 1957. (With a Summary in English.)

The possibility of a connection between the domestic rabbit and tsutsugamushi disease was investigated at Pin-Tan (Fukien) in July and August 1955. It was found that nearly half the farmers reared rabbits, which were fed on grass gathered in the fields and scattered inside the house. It was thus evident that Trombiculids brought in on the grass might crawl on to people as well as on to the rabbits. *Trombicula deliensis* Walch, *Euschöngastia indica* (Hirst) and *Acomatacarus* sp. were found on the rabbits, the first being much the least common. Of 64 rabbits examined, 16 were found to be infected with *Rickettsia orientalis* (*tsutsugamushi*).

Chang (Tsong-pao), Sun (Tao) & Wu (Ching-foo). **Observations on the Blood Feeding Habits and the Time of Activities of the common Species of Mosquitoes in Dairen.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 2 pp. 189–195, 2 figs., 9 refs. [Peking] 1957. (With a Summary in English.)

The total numbers of mosquitos of seven species collected while attacking man, cows, horses, sheep and fowls in selected quarters of Dairen in the summer of 1954 and (in brackets) the approximate percentages taken on man were 4,125 (9) of *Culex pipiens pallens* Coq., 2,420 (3·5) of *Aëdes dorsalis* (Mg.), 1,909 (1·8) of *C. tritaeniorhynchus* Giles, 626 (2·1) of *A. vexans nipponii* (Theo.), 391 (1) of *A. togoi* (Theo.), 50 (2) of *Anopheles hyrcanus sinensis* Wied. and 22 (22·7) of *C. bitaeniorhynchus* Giles. Cows were the preferred hosts of all species except *C. p. pallens*, of which 75·7 per cent. were taken on fowls, and *Aëdes togoi*, of which 23·5 and 49·6 per cent. were taken on fowls and horses, respectively.

Observations were made on the feeding activity of the four more abundant species in each hour from 4–5 p.m. to 6–7 a.m. Each species showed two peaks of activity, with the first higher than the second. The first was at 7–8 p.m. and the second at 3–4, 4–5 and 5–6 a.m., respectively, for *tritaeniorhynchus*, *nipponii* and *dorsalis*, but those for *pallens* occurred between 11 p.m. and 4 a.m. and were separated only by one hour's inactivity at 2–3 a.m.

Wu (Ching-li), Liu (Erh-hsiang) & Fu (Hsiu-cheng). **Epidemiological Survey of Filariasis Bancrofti in south Shantung, China.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 3 pp. 242–255, 4 figs., 16 refs. [Peking] 1957. (With a Summary in English.)

The results are given of an epidemiological survey of filariasis in three villages on the plain in the southern part of Shantung, which is the northernmost province of China in which the disease is known to be endemic.

The infection rate, including elephantiasis, averaged 23·78 per cent., and the parasite concerned in all cases was *Wuchereria bancrofti*. The commonest mosquitos in the district were *Culex pipiens pallens* Coq., which was particularly numerous in houses, *Anopheles hyrcanus sinensis* Wied. and *C. tritaeniorhynchus* Giles. Dissections of mosquitos taken in human dwellings in one of the villages showed that 134 of 420 females of *C. p. pallens* contained filarial larvae and 59 contained mature ones, while only two of 22 females of *A. h. sinensis* contained larvae and these were immature. The larvae reached the third stage in females of both species, when these were reared in the laboratory and infected experimentally, but the percentages that did so were 60·87 in *C. p. pallens* and only 42·86 in *A. h. sinensis* [*cf. R.A.E.*, B **28** 249], and it is concluded that *C. p. pallens* is the chief natural vector of *W. bancrofti* in this district.

Chen (Hee-shun) & Loo (Hsian-sing). **Isolation of Japanese Type B Encephalitis Virus from Mosquitoes in Shanghai.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 3 pp. 324–330, 14 refs. [Peking] 1957. (With a Summary in English.)

A total of 281 and 35 batches of mosquitos collected in Shanghai in April–October 1954 and May–September 1955 were tested for virus by intracerebral inoculation of suspensions into mice. The only positive results obtained were the isolations of five strains from mosquitos collected in two cow-sheds in July 1955; two were from *Culex pipiens pallens* Coq. and three from *C. tritaeniorhynchus* Giles. Animal range, complement fixation and neutralisation tests showed that all were strains of the virus of Japanese B encephalitis, and it is concluded that attempts to isolate this virus from its insect vectors are most likely to be successful if they are collected in animal sheds at or just before the beginning of the epidemic season.

Doby (J. M.), Deblock (S.) & Gaeremynck (L.). **Régime alimentaire et sensibilité des larves d'*Aedes aegypti* au D.D.T. Influence du taux des lipides de l'organisme.**—*Bull. Soc. Path. exot.* **49** no. 1 pp. 56–64, 4 graphs, 7 refs. Paris, 1956.

Difference in conditions of exposure, some external and some biological, affect the toxicity of organic insecticides both in experiments and in practical use. One factor that has been studied is the lipid content of the insect [*cf. R.A.E.*, B **45** 75, etc.]. In view of evidence that the addition of fat to the diet of flies increased their resistance to DDT [**42** 31], the authors examined the effect of different diets on the lipid content and reaction to DDT of larvae of *Aëdes aegypti* (L.). Some 5,000 larvae were used. They were reared on a suspension of wheat flour, powdered milk or dried brewers' yeast or on a mash of filamentous green algae (*Spirogyra* sp.). The foods were given daily in quantities determined by the amount consumed. Larvae were kept without food for 12 hours and washed before being exposed to DDT and washed again and returned to the former rearing conditions after exposure. Most of the test larvae were in the third instar. Those reared on flour were more resistant than those reared on any of the other three media, among which there was no consistent difference in the various experiments. In a single test with second-instar larvae reared on flour and algae, the former were more resistant. There was no considerable difference in the mortality of larvae reared on the four diets and not exposed to insecticide. Lipids comprised 7·72, 4·41, 5·86 and 11·22 per cent. of the dry weight of larvae reared on flour, algae, yeast and milk, respectively. The experiments confirm the importance of biological factors in assessing the potency of insecticides, but do not confirm the existence of a negative correlation between lipid content and susceptibility to DDT.

Adam (J. P.) & Hamon (J.). **Trois anophèles nouveaux pour le Cameroun** (*A. hargreavesi, A. freetownensis* **et** *A. jebudensis*).—*Bull. Soc. Path. exot.* **49** no. 1 pp. 71–76, 12 refs. Paris, 1956.

Continuing investigations on the bionomics of *Anopheles rageaui* Mattingly & Adam in the French Cameroons [*R.A.E.*, B **45** 122–123], the authors made regular monthly catches of mosquitos from February 1954 to February 1955 in the subterranean tunnel near Yaoundé, and at the same time-intervals sought mosquitos in three inhabited African huts and an unoccupied brick building near the entrance to the tunnel. Catches with human bait under a mosquito-net trap were also made on 19 nights in a dwelling and in the open. Two females of *A. jebudensis* Froud [**33** 32] and one male, two females and probably one larva of *A. freetownensis* Evans were taken in the tunnel and one male of *A. freetownensis* in the brick building. More recently, a larva identified as *A. jebudensis* was taken in the same region by Mouchet. As adults of *A. rageaui* and *A. rhodesiensis* Theo., which also occur in the tunnel, were subsequently found in rock crevices, it is presumed that the natural resting places of *A. jebudensis* and *A. freetownensis* are similar. Neither was taken in traps with human bait or in inhabited huts.

A. hargreavesi Evans was reared from larvae taken among *Pistia* in the Nyong at Ebogo. Like *A. jebudensis* and *A. freetownensis*, it is recorded for the first time in the French Cameroons, but it is possible that previous records of *A. marshallii* (Theo.) there apply to it, as they were based on identification of females caught in huts and the adults of the two species are very similar.

Adam (J. P.), Chwatt (L. J. Bruce) & Hamon (J.). **Contribution à l'étude des Culicidae (Diptères) de la région éthiopienne. Description du mâle et de quelques variations de la femelle et des premiers stades d'** *Anopheles domicolus* **Edwards, 1916.**—*Bull. Soc. Path. exot.* **49** no. 1 pp. 100–108, 1 pl., 5 figs., 4 refs. Paris, 1956.

Larvae similar to those described by Mattingly [*R.A.E.*, B **39** 22] as *Anopheles domicolus* Edw. were taken at the edges of grassy streams in

Haute-Volta and in shallow, sunlit, cement drains in northern Nigeria, and adults of both sexes were reared from them. The pupae also corresponded to Mattingly's description and the females to the descriptions of *A. domicolus* given by Edwards [**4** 64] and Evans [**26** 182]; and the males are described as those of *domicolus*, which were hitherto unknown, one of them (from Haute-Volta) being designated the allotype. However, the females and larvae showed considerable variations, the chief of which are described. The females of *A. longipalpis* (Theo.) as described and figured by Theobald and by De Meillon [**36** 59] as well as those of *A. domicolus* as described and figured by Edwards and Evans could fall within the limits of the variations noted, and males described as *domicolus* also resemble those of *A. longipalpis* described by Theobald and De Meillon. It is concluded that *domicolus* is at most a variety of *A. longipalpis*.

Ovazza (M.), Hamon (J.) & Neri (P.). **Contribution à l'étude des diptères vulnérants de l'Empire d'Éthiopie. I. Culicidae.**—*Bull. Soc. Path. exot.* **49** no. 1 pp. 151–182, 8 figs., 2½ pp. refs. Paris, 1956.

Grenier (P.) & Ovazza (M.). **II. Simuliidae. Simulies et onchocercose.**—*T. c.* pp. 182–196, 3 figs., 3 refs.

Ovazza (M.). **III. Tabanidae.**—*T. c.* pp. 197–204, 2 figs., 5 refs. **IV.** *Glossina*.—*T. c.* pp. 204–209, 1 map, 4 refs.

The first of these reports concerns the mosquitos collected during a survey of the blood-sucking Diptera of Ethiopia carried out during 1953–55, together with some specimens collected subsequently in three localities by workers other than the authors. The parts of the country surveyed are briefly described. The mosquitos taken comprised 58 species definitely identified (of which four were represented by two varieties or subspecies and one by three) and a certain number of tentatively identified species. Data are given on the place of collection and bionomics of each, and some changes in nomenclature and taxonomic details on previously undescribed and incompletely described stages are included.

In the second paper, collection data are given for the 15 species of *Simulium* (two represented by two forms) that were taken in the survey. They include nine not previously recorded in Ethiopia, but do not include *S. griseicolle* Becker, a serious pest species in the Sudan [*R.A.E.*, B **40** 39–40]. Full descriptions are also given of the larva of *S. dentulosum* Roub., hitherto incompletely characterised and of the pupa of a new form, *shoae*, of this species. A zone of onchocercosis (caused by *Onchocerca volvulus*), which is a north-eastern extension of one in the Sudan [**41** 38], occurs in the part of Ethiopia between the valleys of the Omo and Baro and includes Jimma and Kaffa. The authors found that *S. damnosum* Theo., one of the two known vectors of *O. volvulus*, was common in this zone, where it was active for 11 months of the year and attacked man. They also took one female of *S. woodi* De Meillon, which had previously been found there by Giaquinto-Mira and is closely related to *S. neavei* Roub., the other known vector. The country is savannah with forest and has an altitude of 3,300–5,000 ft. *S. damnosum* also occurred on the high plateau (6,300–8,000 ft.) between Jimma and Addis Ababa, where it did not attack man, and in an area further to the east, where it attacked man but was active for only about two months of the year. Onchocercosis is unknown in these two areas, and it is recalled that it is much less widely distributed in the Sudan than is *S. damnosum* [**41** 39].

The third paper comprises a list, with collection data, of the 14 species and varieties of Tabanids taken during the survey. One new species and a new variety of it are described.

In the fourth paper, the distribution of species of *Glossina* in Ethiopia is reviewed on the basis of records in the literature and the results of the survey, during which four species were taken. The genus does not seem to occur above 6,000 ft. *G. palpalis fuscipes* Newst. (*G. f. fuscipes* Newst.) is apparently limited to the Gibbe valley, where it is found throughout the year and attacks man. *G. pallidipes* Aust. seems to be restricted to altitudes between 3,300 and 6,000 ft. It was taken in January and February, which are the driest months of the year but are not completely rainless. It attacked both man and stock. Crithidial forms of a trypanosome were found in the proboscis of one of 26 flies of this species dissected. *G. morsitans morsitans* Westw. apparently replaced *G. pallidipes* from about 3,300 ft. to the Sudan frontier in the Akobo valley, which is an uninhabited area of dry savannah with small trees and virtually constitutes a game reserve. The flies were very abundant in January, when only the largest rivers were flowing. They were found in full sunlight in the middle of the day, and showed little tendency to attack man. *G. tachinoides* Westw. was taken near Akobo on the Sudan frontier. *G. longipennis* Corti is known to occur on the lower Omo down to Lake Rudolph, in the south of Gamu-Gofa and in Sidamo, where tsetses are said to cause the death of stock, particularly mules. *G. brevipalpis* Newst. has been found in the west of Somalia near the frontier of Ethiopia.

Adam (J. P.). **Note faunistique et biologique sur les anophèles de la région de Yaoundé et la transmission du paludisme en zone forestière du Sud Cameroun.**—*Bull. Soc. Path. exot.* **49** no. 1 pp. 210–220, 5 refs. Paris, 1956.

A list is given of 16 species of *Anopheles* taken within 35 miles of Yaoundé in the southern Cameroons over a period of four years, together with data on the frequency with which each of those taken in the adult stage was found by day and night in dwellings and by night outside, and on sporozoite rates and the relative importance of the potential vectors of malaria. Over 5,000 females of seven species were dissected between 25th May 1953 and 21st April 1955. Sporozoites were found in 3·1 per cent. of 1,047 females of *A. gambiae* Giles, 2·6 per cent. of 470 of *A. nili* (Theo.), 1·7 per cent. of 522 of *A. funestus* Giles and 1·4 per cent. of 1,586 of *A. moucheti* Evans, and in one female each among 119 of *A. coustani* Lav. and 1,324 of *A. wellcomei* Theo. No infection was found in 49 females of *A. hancocki* Edw. Other species were not available in sufficient numbers for dissection. Of 1,396 females of *A. moucheti*, 78 of *A. gambiae* and 14 of *A. nili* subjected to the precipitin test, 370, 23 and 5, respectively, contained human blood, 146, 14 and 2 contained blood of sheep or goats, 8, 0 and 0 contained blood of both types, and 872, 41 and 7 gave negative results. The mean density per dwelling of the four species recognised as malaria vectors was very variable from village to village. The highest rates found were 5 for *A. gambiae* and *A. nili*, 3·9 for *A. funestus* and 37·33 for *A. mouchcti*. Out of 85 villages, of which 52 were examined regularly every month, the numbers in which each species was present, and (in brackets) in which it was dominant, were 31 (26) for *A. gambiae*, 19 (3) for *A. moucheti*, 13 (6) for *A. funestus* and 9 (5) for *A. nili*. This shows the paramount importance of *A. gambiae* as a vector. The other three species may be very important locally, but are not widespread.

When experimental control by insecticide treatment of huts was introduced in some of the villages, those in which *A. nili* and *A. funestus* were dominant were dealt with in the first months and both species were virtually eradicated. Villages where *A. moucheti* was being studied were not treated, and it remains abundant. *A. gambiae* practically ceased to be taken by day in treated huts but persisted in night catches with human bait both in huts and outside. It had caused surprise in 1950 that malaria endemicity in a group of treated villages about 43 miles north-west of Yaoundé was relatively high while the numbers of *A. gambiae* resting in dwellings by day were very small, but it was observed in the present investigations that transmission may be effected by females of this species that enter the huts only to feed and by females that feed in the open as well as by those that rest in the huts. These last were important only for limited periods when the rains had made breeding places available very near the huts. Suggested explanations of the change in the behaviour of *A. gambiae* with regard to resting in huts are the development of aversion from insecticide-treated walls or the existence of different biological races [*cf. R.A.E.*, B **43** 173]. The importance of *A. moucheti*, which clearly can be great in the few villages in which it is abundant [*cf.* **45** 122–123], is limited considerably by the virtual restriction of the larvae to large rivers with *Pistia stratiotes*. They occasionally developed in small streams, but only in very small numbers. Adults were never taken at more than ¾ mile from a breeding place. The larvae of *A. funestus* and *A. nili* are found throughout the forest region, and the combinations of conditions necessary to make these species dominant are not yet known. An important limiting factor is probably the scarcity of huts near streams. *A. funestus* is favoured by the establishment of fish-ponds near villages. In one village, *A. nili* bit in huts at night without resting, but outdoor biting was not demonstrated for either species.

DE ROOK (H.). **Report of an Investigation on Filariasis in the Berau Region (Inanwatan District, North-West New Guinea).**—*Tech. Pap. S. Pacif. Comm.* no. 105, vi + 19 pp., 2 maps, 2 graphs, 18 refs., multigraph. Nouméa, 1957.

The Berau region of Netherlands New Guinea, which extends along the north shore of McCluer Gulf and is in the administrative district of Inanwatan, consists of a dry sandy coastal tract about two miles wide and an extensive fresh-water swamp, locally known as " Telaga Kokoda ", about 20 miles long and 9 miles wide. There are six villages in this swamp, completely surrounded by water, and elephantiasis is known to be common in them. The incidence and vectors of filariasis in two of them (Negeri Besar and Kasueri) were studied in detail by the author in 1955. The parasite is the nocturnal form of *Wuchereria bancrofti*. The whole population of the two villages except children less than one year old was examined, and 21·2 per cent. of the 857 persons at Negeri Besar and 19·6 per cent. of the 322 at Kasueri were found to have microfilariae in the peripheral blood. Filarial disease rates for the two villages were 10·9 and 6·2 per cent., respectively. A classification of the 114 cases of gross manifestations of filariasis recorded is given. The microfilarial rate in people with symptoms was not different from the rate in those without them. It was slightly higher in males than in females.

Mosquitos caught in houses in the two villages, some of which were identified by Bonne-Wepster [*R.A.E.*, B **45** 161], comprised *Mansonia* (*Taeniorhynchus*) *uniformis* (Theo.), *M.* (*T.*) *papuensis* (Taylor), *M.* (*T.*) *nigrocloracea* (Bonne-Wepster), *Aëdes kochi* (Dön.), *Tripteroides* sp. and six species of *Culex*. *C. annulirostris* Skuse, *M. uniformis* and *C. bitaeniorhynchus* Giles together formed 90 per cent. of the total. Of 184, 227 and 142 females of these three species dissected, 25·5, 19·8 and 19·7 per cent., respectively, had filarial infections and 1·6, 1·3 and 2·1 per cent.

had infective-stage larvae. Experimental feeding on carriers of microfilariae resulted in infection rates of 94·2, 89·7 and 87 per cent. in these species, and also in infection in all of three females of *A. kochi* and three of *M. papuensis*, none of which lived long enough for the larvae to complete their development. The infective stage in the other three species was reached on the 12th day after the infective meal, and the proportion of females dissected after this time that contained mature third-stage larvae was very high. These larvae were sometimes in the head and sometimes in the abdomen. The three species were clearly anthropophilous and were often taken resting in houses in the daytime, when *M. uniformis*, *C. annulirostris* and *C. bitaeniorhynchus* formed 40·3, 35·1 and 11·3 per cent. of the catch, respectively, although *C. bitaeniorhynchus* was the dominant species in the region [*cf. loc. cit.*]. The two species of *Culex* bred intensively in the marsh round the dwellings. The host plant of the larva of *M. uniformis* was not discovered in spite of careful searching. One larva was found on *Ipomoea aquatica*.

No Anopheline larvae or adults were found in the area during the investigation, and though several cases of malaria were seen, the infections had probably been acquired elsewhere. Available evidence indicates that the main vectors of *W. bancrofti* in New Guinea are species of *Anopheles*, including *A. bancrofti* Giles [**25** 257], *A. karwari* (James) [**44** 165] and, in particular, *A. farauti* Lav., but the possibility that mosquitos of other genera play a part in various areas needs investigation. Possible measures for the control of filariasis in the Telaga Kokoda villages are discussed, and it is concluded that the only possible one is house-treatment with insecticides against the vectors.

LAIRD (M.). **Studies of Mosquitoes and Freshwater Ecology in the South Pacific.**—*Bull. roy. Soc. N. Z.* no. 6, [1+] 213 pp., 5 pls. (3 col.), 44 figs., 10½ pp. refs. Wellington, N. Z., 1956.

The danger that Anophelines, and particularly species that transmit malaria, may be introduced into hitherto uninfested and malaria-free parts of the South Pacific is discussed in the introduction to this bulletin, in the light of knowledge on their distribution there [*cf. R.A.E.*, B **14** 110; **30** 185–186; **44** 191–193] and available means of transport. They are absent from that part of the Pacific east of 170°E., from all Micronesia except Guam [**41** 189] and from islands east of Australia and south of 20° 12′ S. [*cf.* **42** 116], including New Caledonia [*cf.* **30** 186; **40** 187; **42** 117]. A few small and generally very remote islands north of 20° 12′ S., west of 170°E. and south of Micronesia (the Belep Group [**42** 117], Nauru, Ocean Island and some small units of the otherwise infested New Hebrides and Solomons) are also free of them.

The bulletin contains the results of a study of mosquito ecology in the South Pacific with particular reference to Anopheline distribution; it was made between June 1952 and June 1954 and took the form of a detailed comparison between potential breeding places for mosquitos in malarious parts of the western Pacific and in various Anopheline-free islands. The areas studied were in Queensland, the Solomon Islands, the New Hebrides, New Caledonia, the Loyalties, Fiji, Tonga, Western Samoa and representative islands of the Cook, Gilbert, Ellice and Tokelau Groups. The characteristics of each of the 457 potential breeding places examined, and the mosquito species taken in it, if any, are tabulated. Immature stages of mosquitos were found in 372. Details are given of the various groups of fauna and flora found in the habitats, and of parasites and ectocommensal organisms associated with the mosquitos. There were 54 species of mosquitos, including six of *Anopheles*. *A. bancrofti bancrofti* Giles, *A. stigmaticus* Skuse, *A. annulipes* Wlk. and *A. farauti* Lav. were found in Queensland. *A. farauti*, *A. punctulatus* Dön., and *A. solomonis* Belkin, Knight & Rozeboom in the Solomons, and *A. farauti* in the New Hebrides. The parasites included four species of *Coelomomyces*, each obtained from a single larva. They were *C. solomonis*, sp. n., from *A. punctulatus* in Guadalcanal, *C. cairnsensis*, sp. n., from *A. farauti* and *C. indiana* from *Aëdomyia catasticta* Knab, both in Queensland, and *C. stegomyiae* from *Aëdes scutellaris scutellaris* (Wlk.) in Rennel. A list with host records is given of the 18 species of *Coelomomyces* that had previously been described, all but one of them from larvae or adults of mosquitos, and the characters and classification of some of them are discussed. The latter include the parasites of *Anopheles* spp. that were described by van Thiel as *C. ascariformis* and *C. walkeri* [**43** 68–69]. It is considered that the name *ascariformis* should apply to the species from Sierra Leone designated type 4 by Walker, but not to the species found by Manalang in the Philippines, which is closely allied to, if not conspecific with *C. indiana*, and also that it is not certain whether Walker's type 1 is identical with *C. walkeri* (from Java) or whether it is merely an immature stage of type 4 (*ascariformis*).

The ways in which the habitats of mosquito larvae have been classified are reviewed, and a new classification is proposed that is thought to be particularly applicable to Pacific conditions and to lend itself to the systematic study of the ecology of the various bodies of water. The utilisation of these habitats by the various groups of aquatic animals and plants is discussed, with particular reference to the diminishing representation of certain groups towards the east [*cf.* **16** 70]. Finally, the factors influencing the distribution of *Anopheles* in the South Pacific are dealt with. It is concluded that the continued absence of the genus from certain islands of the malarious zone such as Bellona (Solomons) and Tutuba (New Hebrides) and from the perimeter islands of Futuna (New Hebrides), Art (Belep Group) and Uvea (Loyalties) can be explained on the basis of biological and other factors that differ from island to island but agree in presenting ecological barriers. However, there appear to be no barriers that would prevent the establishment of *Anopheles* in the general area east of 170°E. Should *A. farauti* reach Fiji and tropical Polynesia, it would find its whole range of accustomed larval and adult habitats there. Moreover, the extension of south-east Asian fish-pond techniques to the South Pacific will increase the numbers of larval habitats available. Maintenance of efficient insect-control measures at airports and seaports is considered to be of great importance, and investigation into the local potentialities of biological control is advocated. The Tokelau Islands are considered particularly suitable for such research, and subjects for investigation are suggested.

MATTINGLY (P. F.). **Species Hybrids in Mosquitoes.**—*Trans. R. ent. Soc. Lond.* **108** pt. 2 pp. 21–36, 3 figs., 3 pp. refs. London, 1956.

Certain observations and experiments relating to species crosses and some intraspecific crosses in mosquitos are discussed, either because of their wide biological interest or because they have been wrongly interpreted. Notes are included in some instances on the taxonomy, bionomics, distribution, population genetics and phenotypic variability of the species under consideration. In the case of crosses between populations of *Culex pipiens* var. *molestus* Forsk. showing various degrees of reproductive isolation [*R.A.E.*, B **41** 120; **43** 49; **45** 67], work has been directed to the geographical distribution of mating types and the cytological basis of the reproductive incompatibility that they exhibit. It has been shown that there are at least eight different groups of *molestus* populations, some of which are genetically isolated and some correlated by a strictly unilateral flow of genes. Laven demonstrated a purely maternal type of inheritance and showed by the use of marker genes [**45** 135] that it is not attributable to parthenogenesis. He also showed that the lethal factor concerned operates, in the main, only when the embryo has developed to a late stage within the egg and that the factor is transmitted to the offspring in the cytoplasm, including the cytoplasm of the sperm [**43** 49]. General features of the complex of *Culex pipiens* L. are summarised, and reference is made to the hybridisation of *molestus* and *C. globocoxitus* Dobrotworsky [**44** 82–84, etc.], which have very distinct male terminalia, though the phallosomes of the two are closely similar. Of the two hybrid males examined by the author, one had terminalia not notably distinct from those of *molestus*, whereas the other had terminalia intermediate between those of *molestus* and *globocoxitus*.

Cytoplasmic inheritance has also been postulated to explain the maternal inheritance of morphological characters in crosses between *Aëdes aegypti* (L.) and *A. albopictus* (Skuse) [*cf.* **27** 263; **40** 107], but the author believes that there are good grounds for rejecting the hypothesis in the case of these crosses and for postulating a chromosomal mechanism to account for the phenomena observed. *A. aegypti* and *A. albopictus* are very distinct morphologically. Toumanoff crossed them in both directions [**26** 98; **27** 47. 263], but obtained only very small numbers of viable offspring when *aegypti* was the female parent. Hoang-Tich-Try confirmed the possibility of crossing *albopictus* females and *aegypti* males [**27** 263], but other workers were successful only with the opposite cross [**40** 106] or were unsuccessful in making the cross in either direction [**31** 2]. In all the successful crosses, the progeny resembled the female parent, and there appeared to be little or no loss in viability or potency in the hybrid offspring. Toumanoff was unable to cross Indochinese *albopictus* with Indian *aegypti* in either direction [**27** 263], and MacGilchrist [**1** 162] had long before noted that copulations between *aegypti* and *albopictus* (*scutellaris*, auct.) in Calcutta appeared to be unproductive. This suggests a resemblance to the geographical variation in compatibility seen in *C. p. molestus* [**43** 49]. So far, the resemblance to the *Culex* crosses seems close. Yet, in an F_4 generation, Toumanoff [**27** 47] obtained one female that threw back to the paternal species and appeared as typical *aegypti* though with reduced viability. This throwback is inconsistent with any hypothesis involving cytoplasmic inheritance, since it indicates the survival through four generations of paternal chromosomal characters. The same applies to a result later obtained by D. D. Bonnet when he back-crossed F_1 hybrids of *aegypti* and *albopictus* to the paternal *albopictus*. Only one out of 175 eggs hatched, and this one produced a typical male *albopictus*. These phenomena cannot be accounted for by parthenogenesis or by preconditioning of the cytoplasm by the maternal nucleus, nor are they comparable to the phenomena observed in *Culex*. It seems certain that the whole or a part of the paternal chromosome complement persists in the hybrids while remaining unexpressed in respect to the characters so far studied. Further progress in the elucidation of the mechanism involved depends on direct observation of the chromosomes. The provision of sufficiently good preparations of the chromosomes is discussed. A suggested line of indirect approach is the study of the disturbance of the sex ratio in the hybrids.

Hybridisation between *aegypti* and *albopictus* in nature, if this were proved to occur, would be of considerable practical significance, since both are important disease vectors. Rozeboom, in a paper already noticed [**40** 64], produced evidence that these two species do not interbreed if the males have a choice between females of their own species and those of the other.

It cannot be assumed that such a free choice is always available in nature, but natural hybridisation in such circumstances would be likely to be rare. If it takes place, and if all hybrids have the characters of the female parent, they would be difficult to detect without back-crossing or the sporadic occurrence of throwbacks. However, it seems possible that while major characters are inherited from the female parent alone, smaller characters may be derived from the male [*cf.* **40** 185].

In coastal areas of Africa and in some other parts of the world, *A. aegypti* is extremely variable, probably because of hybridisation between the local dark forms and pale strains [*cf.* **45** 134] from more arid parts of the range. The frequent occurrence of pale coloration in *C. p. molestus* and in many desert mosquitos had led the author to conclude that this coloration might be associated with a cryptozoic habit, and E. C. C. van Someren, who examined 239 individuals caught in houses and 130 caught in the bush in the Mombasa area of Kenya, found that 232 of the former were pale and 125 of the latter were dark. The only known close relatives of *A. aegypti* are two pale forms, *A. mascarensis* MacGregor [**12** 115] and *A. vinsoni* Mattingly [**41** 146], both apparently confined to Mauritius. *A. aegypti* was mainly represented by the pale form in Mauritius, and J. G. Halcrow suggests that it may have been introduced by Arabs about 1,000 A.D. *A. aegypti* has now been eradicated from Mauritius. The fate of the other two is not known, but since *A. mascarensis* is a wild form, it has probably survived. *A. vinsoni* is known only from one specimen, and it seems possible that it may represent the type of aberrant form that tends to appear towards the end of an eradication campaign.

Five of the mosquitos included in the group of *A. scutellaris* (Wlk.) have been the subject of hybridisation experiments. Woodhill found that *A. s. scutellaris* and *A. s. katherinensis* Woodhill were fully compatible in one direction and totally incompatible in the other [**38** 176]. Back-crossing showed the male hybrids to be wholly incompatible with the females of the paternal strain (*katherinensis*), but the other three possible back-crosses were completely successful [**40** 106]. Smith-White [**40** 106] suggested an explanation similar to that adduced by Laven for *C. molestus*. Woodhill also crossed *scutellaris* and *katherinensis* with *A. pseudoscutellaris* (Theo.) and found the latter to be wholly incompatible with either [**40** 106]. He considered that, although the compatibility was not reciprocal, sympatric populations of *scutellaris* and *katherinensis*, if any exist, would probably hybridise to a significant extent in nature and that *katherinensis* should therefore be treated as a subspecies. Perry [**39** 210] came to the opposite conclusion with regard to *scutellaris* and *A. pernotatus* Farner & Bohart, which he crossed in the New Hebrides, where they are sympatric. The only form other than *katherinensis* for which subspecific status has been suggested is *A. polynesiensis* Marks, as it has been successfully crossed with *A. pseudoscutellaris* in both directions, though with a marked reduction in the rate of hatch [**42** 161; **43** 203]. Rozeboom & Gilford observed definite preference for mates of the same form [**43** 203], which might operate against cross-mating in nature.

MASTBAUM (O.). **Past and present Position of Malaria in Swaziland.**—*J. trop. Med. Hyg.* **60** no. 5 pp. 119–127, 5 graphs, 10 refs. London, 1957.

Results are given of a malaria survey made in Swaziland in 1945–46 before measures for the control of Anophelines [*R.A.E.*, B **43** 111] had been begun. They show that transmission was seasonal, with disappearance of the main vector, *Anopheles gambiae* Giles, in the bush veldt (altitude 500–1,500 ft.) and middle veldt (about 2,000 ft.) during winter, and that malaria was practically absent from the high veldt (about 3,500 ft.) except in years of very high rainfall when *A. gambiae* extended its range and transmitted the disease among the non-immune population. Hut spraying was begun in 1949–50 when DDT was used over an area of some 2,000 sq. miles. In subsequent years, BHC was used and almost all native areas of the bush veldt and middle veldt were treated. European farms were included from 1954 onwards. Dieldrin was substituted for BHC in two large bush-veldt areas in the malaria seasons of 1955 and 1956 [*cf.* **44** 138–139]. Measures against the larvae in an irrigated area [**43** 111] reduced numbers of *A. gambiae* to some extent but did not seem to influence malaria incidence and so were discontinued.

In 1956, parasite rates in children less than 1, 1–5 and 6–16 years old were 0, 0·7 and 2·1 per cent., respectively, in the bush-veldt areas and 0, 3·6 and 5 per cent. in irrigation areas. It is concluded that transmission had been totally interrupted in the bush veldt, as it had already been in the middle veldt, and it was apparently interrupted in the irrigation areas in 1956 for the first time. It is not certain that all the cases in older children in the irrigation zone were acquired in Swaziland. Only three females and two males of *A. gambiae* were found in the many hundreds of huts examined in various areas in 1956, but larvae were present in many breeding places in the bush veldt and there was slight evidence of the existence of females, probably in small numbers, that would bite in the open. It is not known whether there has been any increase in the numbers of females resting out of doors during the period of treatment, but they were small before it. Spraying has now been discontinued in a large middle-veldt area in which no transmission occurred in 1955 or 1956, and is to be stopped in other areas, including some parts of the bush veldt. The cost of the control scheme is discussed.

A. funestus Giles diminished greatly in numbers very soon after the beginning of control, and adults disappeared from huts and larvae became very scarce from the second year. It now seems to have disappeared from Swaziland entirely, as it has done from Mauritius [**43** 5–6], but A. Soeiro reports that it persists in small numbers in suburban districts of Lourenço Marques (Portuguese East Africa), despite the exercise of intensive measures against adults and larvae over many years.

PAPERS NOTICED BY TITLE ONLY.

KOHLS (G. M.). **Insects of Micronesia. Vol. 3 no. 3. Acarina: Ixodoidea.**—pp. [3+] 85–104, 8 figs., 1 map. Honolulu, Bishop Mus., 1957. [*Cf. R.A.E.*, B **45** 87.]

OLDROYD (H.). **Collecting, Preserving and Studying Insects.**—$9\frac{1}{4} \times 5\frac{3}{4}$ ins., 327 pp., 12 pls., 135 figs., 1 map, 5 pp. refs. London, Hutchinson & Co. Ltd., 1958. Price £1 5s. [See *R.A.E.*, A **46** 138.]

THOMAS (I.) & JANSON (H. W.). **Common Names of British Insect and other Pests.**—*Tech. Bull. Minist. Agric.* no. 6. iii + 48 [+1] pp. London, H.M.S.O., 1957. Price 7*s*. 6*d*. [Revised list: *cf. R.A.E.*, B **40** 72.]

Reid (E. T.) & Woods (R. W.). **Anopheline Mosquitoes of Southern Rhodesia: a general Survey.**—*Proc. Rhod. sci. Ass.* **45** pp. 47–72, 24 figs., 25 refs. Bulawayo, 1957.

The topography and climate of Southern Rhodesia are described, the distribution of the 38 species and varieties of *Anopheles* that have been recorded there is discussed and shown on maps, and notes on larval and adult habitats are given. The two chief vectors of *Plasmodium falciparum*, the most widespread malaria parasite, are *Anopheles funestus* Giles, which transmits endemic malaria where this occurs, and *A. gambiae* Giles, which is responsible for epidemics. Dissections by H. S. Leeson and C. V. Meeser showed total infection rates and (in brackets) sporozoite rates of 10·2 (5·1) in *A. funestus*, 9·75 (4·05) in *A. gambiae*, 0·79 (0·79) in *A. pretoriensis* (Theo.), 0·22 (0·22) in *A. rufipes* Gough, 1·4 (0) in *A. rhodesiensis* Theo., 1·2 (0) in *A. maculipalpis* (Giles) and 0·3 (0) in *A. coustani* (Lav.). Of the last five, the only one considered of possible importance as a vector is *A. maculipalpis*, which frequents houses and attacks man in Southern Rhodesia and has shown a much higher infection rate in the French Cameroons [*R.A.E.*, B **33** 2]. *A. rufipes* is the most abundant and widespread Anopheline in Southern Rhodesia and *A. coustani* is prevalent in houses in the Salisbury area but, like *A. pretoriensis*, they seldom bite man, and *A. rhodesiensis* is only occasionally found in houses.

The seasonal incidence of Anophelines indicates that those that breed in streams show little change in numbers, but *A. gambiae* and other species that breed mainly in pools show great variations. They are most plentiful in February and March. The seasonal incidence of malaria is closely correlated with that of *A. gambiae*. The numbers of *A. funestus* decreased and those of *A. gambiae* increased between 1926 and 1948, but the reasons are not clear. The distribution of *A. gambiae* shows an annual advance to higher areas with rising temperature and a regression to lower altitudes with the coming of winter. Measures that have been used for the control of Anophelines are discussed. At present, native huts in reserves around the Central Plateau are sprayed with a BHC wettable-powder suspension to form a barrier [**44** 65], the reserves chosen depending on the annual advance and regression of *A. gambiae*. This obviates the need for control on the plateau itself.

Duke (B. O. L.). **Experimental Transmission of** *Loa loa* **from Man to Monkey.**—*Nature* **179** no. 4574 pp. 1357–1358. London, 1957.

Three young drills (*Mandrillus leucophaeus*) caught in the rain-forest near Kumba, in the British Cameroons, were kept in screened cages for six months, during which period frequent examination failed to reveal the presence of microfilariae in their day or night blood. Adults of *Chrysops silacea* Aust. caught in nature were then fed on a human volunteer whose blood contained more than 1,000 microfilariae of *Loa loa* per 50 cu. mm. and kept in the laboratory on a diet of sugar-water. After 9–10 days, the survivors were dissected and the infective forms of *L. loa* found in them were inoculated subcutaneously into the monkeys. Diurnally periodic *Loa* microfilariae appeared in the peripheral blood of all three, 5–6 months later [*cf. R.A.E.*, B **44** 120]. Two of the monkeys were subsequently autopsied, and small adults of *Loa* closely resembling *L. loa* from man were found in each. There is, however, good evidence that *L. loa* is very rarely transferred from man to *M. leucophaeus* under natural conditions in the rain-forest of the British Cameroons. The form of *Loa* commonly found in naturally infected drills and other monkeys (*Cercopithecus nictitans martini* and *C. mona mona*) has microfilariae with nocturnal periodicity [**44** 119,

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120] and is larger than the human parasite when the latter is fully developed in *M. leucophaeus*.

The results of inoculation into *M. leucophaeus* of the infective forms of *Loa* carried by naturally infected species of *Chrysops*, followed by observation of the microfilarial periodicities of the infections that develop, have indicated that the monkey parasite is transmitted among the simian population by *C. langi* Beq. [*cf.* **43** 123; **44** 119, 121] and *C. centurionis* Aust. [**38** 141; **40** 78], crepuscular, canopy-dwelling species that normally do not bite man, whereas the human parasite is transmitted by *C. silacea* and *C. dimidiata* Wulp, which have habits that bring them into close association with man. There is no evidence that the nocturnally periodic simian parasite is ever transmitted successfully to man under natural conditions, and only very rarely is the diurnally periodic parasite of man naturally transmitted to monkeys, presumably by *C. silacea* or *C. dimidiata* [*cf.* **45** 200].

Jordan (A. M.). **The Mating Behaviour of Females of** *Glossina palpalis* **(R.-D.) in Captivity.**—*Bull. ent. Res.* **49** pt. 1 pp. 35–43, 1 graph, 11 refs. London, 1958.

The following is largely based on the author's summary. Various aspects of the mating behaviour of females of *Glossina palpalis* (R.-D.) when they were caged with virgin males seven days old were studied in the laboratory. Individually marked females were used. The mating cages measured 7 × 6 × 6 ins., and all flies were given the opportunity of feeding on goat blood before they were put in them. There were normally six females per cage and always twice as many males. Virgin females that were 1–3, 4–9 and 10 days old mated for average periods of about 120, 75 and 54 minutes, respectively. Mating was relatively infrequent in those one day old and most frequent in those 2–3 days old. In females older than this, its frequency decreased with increasing age [*cf. R.A.E.*, B **43** 170].

Females up to ten days old were willing to mate several times. Of 103 that were kept with males for five hours a day on the first six days of their life and (in brackets) 103 similarly kept when 5–10 days old, the numbers that mated 0, 1, 2, 3, 4 and 5 times were 4 (29), 25 (53), 43 (14), 21 (5), 6 (2) and 4 (0). The number of females prepared to mate a second time when they were more than ten days old was very small. It was evident in these experiments and a subsequent one that mating frequency of virgin females was much greater than that of previously mated ones of the same age, and this seemed to be due to a decrease in desire for mating by the females rather than a loss of attractiveness to the males.

It is suggested that the proportion of young females of *G. palpalis* that are prepared to mate on a number of occasions is considerable in nature, but that the desire for mating is extinguished much sooner in life in mated females than it is in virgin females. It has been generally assumed that one mating is sufficient to supply a female of *Glossina* with sperm for life. If repeated mating is common in nature [*cf.* **40** 144], any means of eradicating *Glossina* based on the release of sterilised males [*cf.* **44** 103] would be impracticable, as a female that had mated with a sterilised male might mate again with an unsterilised one.

Colless (D. H.). **An improved Technique for permanent Mounts of small Insects and Nematodes.**—*Bull. ent. Res.* **49** pt. 1 pp. 45–47, 2 refs. London, 1958.

The essential feature of the mounting method here described is the transfer of the specimen to a slide in a drop of phenol to which dry, powdered balsam is then added. When the balsam has dissolved, the mount is dried and covered in the usual way. The method was developed for mosquito larvae but has also proved of value for other small arthropods, including adult Diptera, fleas and ticks, and for certain nematodes. Two clearing methods are also described.

MacLennan (K. J. R.) & Kirkby (W. W.). **The Eradication of *Glossina morsitans submorsitans* Newst. in Part of a River Flood Plain in Northern Nigeria by chemical Means.**—*Bull. ent. Res.* **49** pt. 1 pp. 123–131, 3 figs., 4 refs. London, 1958.

Glossina morsitans Westw. (represented by subsp. *submorsitans* Newst.) infests one-sixth of the area of Northern Nigeria, and is of great economic significance there as a vector of trypanosomiasis of cattle. Differences have recently become apparent in its ecology in the Guinea and Sudan savannah zones; it is relatively widespread and diffuse in the former, but it is restricted in the latter to linear strips associated with river flood plains. In view of the possibility that this restriction might make control practicable, measures aimed at the eradication of the fly were taken as an experiment in January–April 1956 in a focus covering an area of seven square miles between Azare and Potiskum, and isolated from the main one by a natural barrier five miles wide. The district has a severe dry season lasting from October to May. In the second half of this season, almost the whole *morsitans* population is concentrated in islands of evergreen forest, which in the experimental area amounted to only about 200 acres. They were surrounded in the flood plain by savannah woodland and seasonal or permanent swamp. Beyond the margins of the flood plain were cultivated areas and upland savannah woodland. In addition to those concentrated in evergreen forest, a few flies persisted until well into the dry season in areas of *Mitragyna inermis*, which loses its leaves late. The source of food was mainly wart-hogs, which were numerous. *G. tachinoides* Westw. was also present, and measures were taken to control it, but these are referred to only incidentally.

Possible measures for eradicating *G. morsitans* are briefly discussed, and the reasons for adopting the one employed are given. A spray containing 5 per cent. DDT in wettable-powder suspension was applied in March 1956, during the second half of the dry season, at a rate of about 7 lb. DDT per acre to the evergreen forest islands, which had previously had paths slashed around and through them. Pneumatic knapsack sprayers were used, and vegetation was sprayed to a height of 7–8 ft. A preliminary trial in the early rains of 1955 had shown that, for up to six weeks after application of the insecticide, flies from unsprayed forest put in contact with sprayed leaves and bark died in three hours, whereas controls remained alive for 24 hours, but the good persistence of the deposit in the main experiment was further favoured by the lack of rain and the fact that the vegetation was dormant. There was a rapid decline in the population of *G. morsitans* after spraying. The fly persisted longest (five weeks) in a site associated with *M. inermis*. A second application of the spray, 4–5 weeks after the first, was made in two sites, including this one, to ensure eradication of *G. morsitans*, and in others for the control of *G. tachinoides*, but part of the area was sprayed only once, and one application would probably have eradicated *G. morsitans* elsewhere, as it could not be found in the sprayed area for 18 months after its disappearance about the end of April. The cost of the insecticide and labour to apply it amounted to £700, whereas it was estimated that clearing would have cost at least £6,000. The final result regarding *G. tachinoides* was indefinite, as distribution of this species was continuous.

Lewis (D. J.). **Some Mosquitos of the Blue Nile Valley in the Republic of the Sudan.**—*Bull. ent. Res.* **49** pt. 1 pp. 133–155, 2 pls., 5 figs., 56 refs. London, 1958.

More than 50 species of Culicidae have been recorded by the author [*R.A.E.*, B **44** 196; **45** 21, 25] from the Blue Nile valley in the Sudan, but the present paper consists largely of information on the prevalence, breeding places and habits of *Anopheles gambiae* Giles, *A. rufipes* (Gough) and *A. pharoensis* Theo. based on observations made in the Gezira at various times between 1935 and 1955 and during visits to Sennar between 1936 and 1940 and in a few subsequent years before 1951. The dry season is long throughout the Blue Nile valley. Rainfall diminishes from south to north and mosquitos tend to do the same, but the natural conditions have been somewhat altered by irrigation, chiefly the damming of the river at Sennar and the watering of a large part of the Gezira plain. The construction of a proposed dam at Roseires will make a further change, and conditions will probably be somewhat different from those at Sennar on account of the higher rainfall.

This rainfall is probably responsible for the common occurrence of *Anopheles funestus* Giles on this part of the river. Downstream from Roseires, it occurred in several places as far north as Abu Hugar, which is probably about the northern limit of its range. It bred in riverside basins. and *A. gambiae* and *A. pharoensis* were among the many other mosquitos found in or near them. These basins, which are commonly known as sunt forests, because sunt (*Acacia arabica*) is the dominant tree in them, are an important feature of the Blue Nile. They occupy areas ranging from 100 to over 1,000 acres, and one occurs at each bend of the river from Roseires to Khartoum. They are separated from it by banks about the height of an average flood and are frequently inundated, naturally or by short canals. In the section of the river from just below Abu Hugar to Sennar, breeding conditions were affected by the Sennar dam. Water at full storage level reaches different heights in the basins according to their distance from Sennar, and this affects the duration of flooding in them. At the south of the section, *A. gambiae* bred in the very large flooded sunt forests during the rains and continued to breed there in small numbers in marginal pools in the winter. Further north towards Sennar, irrigation by pump has increased breeding places available for it.

Near Sennar, the dam, which serves both to divert water into the canal that supplies the Gezira and to make a reservoir to supply the Gezira from February to April, had a particular effect on the aquatic vegetation and the mosquitos. Over large areas, creeping grass (*Echinochloa stagnina* and *Vossia cuspidata*) grew on silt under conditions that caused it to form a raft that rose and fell with the water. *A. pharoensis*, which was by far the commonest Anopheline, bred in these grasses [**27** 87] and caused much annoyance by biting. Observations in a village showed that the adults rested in herbage near houses by day at certain times of the year and also in shelters of sorghum straw that are built on to houses after harvest, and it appeared possible that they might play some part in the transmission of malaria [*cf.* **36** 134] during February, August and September. Control of the grass was attempted in 1935 and 1936, but was difficult and expensive, and appeared to entail the risk of favouring more dangerous species of mosquitos. Measures against the adults of *A. pharoensis* should include the use of repellents, netting and screening, insecticide treatment of the sorghum-straw shelters and the clearing of herbage and straw from the neighbourhood of houses. *A. gambiae* bred among *Najas pectinata*, which, however, occupied only a small area of the reservoir and was soon stranded, and it is considered unlikely that a short breeding period at a very hot and dry time of year led to much transmission of malaria. *A. rufipes* was more plentiful than *A. gambiae* and bred in small numbers in various types of vegetation, including creeping grasses, and in water without a thick cover. Breeding conditions in the Sennar reservoir somewhat resembled those in the Jebel Auliya reservoir on the White Nile [**36** 133–134], but there were certain differences, which are discussed. They were principally due to the considerable gradient of the Blue Nile and the heavy load of silt that it carries in the flood season.

In the riverain area between Sennar and Khartoum, *A. gambiae* bred in residual pools in the river-bed in the dry season and in flooded sunt basins in the rains. Control of the larvae was very difficult in the sunt basins both here and higher up the valley, and much reliance was put on insecticide treatment of houses against the adults.

Breeding conditions in the Gezira irrigated area [**27** 87] are described with particular reference to the effect of the heavy clay soil. This is almost impermeable and so does not allow water to seep through banks and form pools or to sink to the water table and rise again to form swamps. It also develops large cracks, which help to drain it. Many larvae of *A. gambiae* were seen in field channels at the end of the rains when irrigation began and in March when the summer started, but the high larval population in March was not reflected by any evident increase in the number of adults, probably because their lives were shortened by the very hot dry weather. *A. rufipes* was sometimes found in houses. Control measures that have been taken against *A. gambiae* over the years are briefly described. House treatment with BHC has superseded measures against the larvae, but attention is drawn to the particular danger of the development of resistance because, owing to a dearth of other resting places, most of the adults rest in houses by day. Brief notes are given on the occurrence of *A. gambiae* and certain other mosquitos at Khartoum and a few other areas within the Blue Nile valley.

Bar-Zeev (formerly Wolfinsohn) (M.). **The Effect of Temperature on the Growth Rate and Survival of the immature Stages of** *Aëdes aegypti* **(L.).**—*Bull. ent. Res.* **49** pt. 1 pp. 157–163, 2 graphs, 10 refs. London, 1958.

The following is largely based on the author's summary. Larvae and pupae of *Aëdes aegypti* (L.) were reared at each of ten constant temperatures from 14 to 38°C. [57·2 to 100·4°F.] in water to which adequate food (bakers' yeast) had been added. Hatching was induced by immersing eggs in water, in four successive groups with an interval of six hours between each, and about 25 of the larvae in each group that hatched in the first ten minutes were transferred to water at the desired temperature and supplied with food. Six hours after the last group hatched, and every 24 hours thereafter, those surviving in each group were recorded and transferred to fresh water, and the exuviae remaining were also recorded. The mid-point of the six-hour period within which the number of individuals that had completed a given stage reached 50 per cent. of the total that finally did so was taken as the average time at which the next stage began.

The curve relating temperature and duration of development from newly hatched larva to adult was found to be hyperbolic, except at the extremes. The later the instar, the lower was the temperature at which growth was most rapid. The threshold of development was observed to lie between 9 and 10°C. [48·2 and 50°F.]. The developmental zero (obtained by plotting the reciprocal of time of development against temperature) was 13·3°C. [55·94°F.], and the average thermal constant for development at temperatures between 16 and 32°C. [60·8 and 89·6°F.] was 2,741 [4,933·8] degree-hours. The highest and lowest temperatures that permitted development from newly hatched larva to adult were 36°C. [96·8°F.] and 14°C. [*cf. R.A.E.*, B **45** 185]. Mortality was high at 14°C. and development irregular. Larvae reared to a given instar at 28°C. [82·4°F.] and then transferred to 38°C. could, with few exceptions, complete only one more instar after transfer.

The average durations of the four successive larval instars and the pupal stage, expressed as percentages of the time taken for newly hatched larvae to reach the adult stage, were 14·6, 13·9, 17·5, 33·3 and 20·6, respectively.

Wiesinger (D.). **Die Bedeutung der Umweltfaktoren für den Saugakt von** *Triatoma infestans.* [The Significance of environmental Factors in Relation to Feeding by *T. infestans.*]—*Acta trop.* **13** no. 2 pp. 97–141, 22 figs., 37 refs. Basle, 1956. (With Summaries in English and French.)

The resting places of *Triatoma infestans* Klug, the activity of the bugs and the stimuli emitted by the hosts were studied in the laboratory with a strain bred from Venezuelan material. *T. infestans* is mainly nocturnal and strongly thigmotactic, resting by day in dark, protected places. Experiments in which the bugs were given a choice of substrata such as they might find in native huts showed that the substance is important only in so far as it provides satisfactory contact. Soil was preferred to loose sand and both to wood, paper or glass, and a dry, coarse, solid substratum was preferred to a loose one. Active insects were not repelled by damp or even wet substrata, and atmospheric humidity did not influence the choice of resting place.

Activity was examined by confining bugs on soot-covered glossy paper on which their tracks could be seen and also by using an actograph. It was found that there was a period of activity at night, that might occur at any time. It was influenced by length of starvation, light and temperature. When the bugs were fed every three weeks, the interval between feeds could be divided into a period of great activity, lasting 1–7 nights and associated with discharge of excrement, a rest period lasting 1–9 nights, and a period of activity caused by increasing hunger. When feeding was fortnightly, the rest period was omitted. This suggests a capacity for adaptation in the bugs. Activity was reduced by strong light, and ceased at temperatures below 20°C. [68°F.].

The apparatus used to study the stimuli that attract the bugs to their host is described. Some 120 tests were made with 1,398 bugs. A current of air at 20–22°C. [68–71·6°F.] exercised practically no attraction and hardly ever induced a feeding reaction (probing of the gauze through which the air was released). When the air-stream was warmed to 36–40°C. [96·8–104°F.], it was attractive, and it stimulated the feeding reaction at 28°C. [82·4°F.] or above. Carbon-dioxide vapour at 36–40°C. was more attractive than air at the same temperature and enhanced the attractiveness of air when mixed with it. A 1 : 1 mixture was the most effective in attracting the bugs and inducing the feeding reaction. A similar unwarmed mixture was not attractive.

Sensory cells were found by amputation experiments and morphologically in the antennae, tarsi and tip of the proboscis, but the antennae seemed to be decisive in locating the host. They distinguished the quality and quantity of stimuli and the direction from which they came. When stimulation was optimum, the proboscis was extended. Bugs deprived of their antennae extended the proboscis even without a stimulus. It seems that the sensory organs at the tip enable them to examine their surroundings and thus orientate themselves. The sense organs on tarsi and proboscis influenced the feeding response when the bugs were in contact with the source of stimulus but could not locate stimuli from a distance. The skin of the host is tested either with the antennae or with the tip of the proboscis.

LEWIS (D. J.). **Chironomidae as a Pest in the northern Sudan.**—*Acta trop.* **13** no. 2 pp. 142–158, 2 figs., 2 pp. refs. Basle, 1956. (With Summaries in French and German.)

Historical data are given on large-scale outbreaks of Chironomids in the Sudan. The midges have occurred in annoying numbers at Khartoum nearly every year since 1927, generally in November and December or in March and April, and cause asthma and other allergic symptoms [*R.A.E.*, B **45** 93]. At Wadi Halfa, they first became a serious pest in 1938. They generally appear in numbers there between January and April and disappear in May or June [*cf.* **44** 67]. They cause even more annoyance than at Khartoum because they fly by day as well as in the evening, and many asthma sufferers have to be evacuated to a special camp in the desert. Antigens prepared from *Tanytarsus* gave many strongly positive reactions in cutaneous tests. *T. lewisi* Freeman is one of the most troublesome species at Khartoum and Wadi Halfa.

Different Chironomids have been used as indicators for different types of European lakes, and the great abundance of *Tanytarsus* in the slow-flowing Nile in the dry season led to a comparison of the Nile with two of the principal types. The sectors that produce Chironomids were found to resemble a large lake, but rather one of the eutrophic or *Chironomus* type than the oligotrophic or *Tanytarsus* type. The lake-like conditions explain why Chironomids are abundant, but not why *Tanytarsus* predominates. Changes occasioned by the construction of dams almost certainly caused the outbreaks of Chironomids, and ways in which they may have done so are discussed. The pronounced dry season and, probably, ponding as a result of dam construction produce ideal breeding places and, with the heat, provide optimum conditions for the Chironomids to develop rapidly, and before their predators become numerous. Ponding probably also allows pupae to accumulate, increasing the rate of adult emergence at Khartoum and Wadi Halfa, and rapid build-up of populations of *Tanytarsus* is further favoured by the ability of the females to oviposit soon after emergence. The northerly winds prevailing in the dry season blow the midges into Khartoum, where they are attracted to the trees and shrubs around the houses. Control is very briefly discussed [*cf.* **44** 67; **45** 93].

GEIGY (R.), MOOSER (H.) & WEYER (F.). **Untersuchungen an Stämmen von afrikanischem Rückfallfieber aus Tanganyika.** [Investigations on Strains of African Relapsing Fever from Tanganyika.]—*Acta trop.* **13** no. 3 pp. 193–224, 6 figs., 8 refs. Basle, 1956. (With Summaries in English and French.)

In 1949, several strains of *Borrelia duttoni* were isolated from individuals of *Ornithodoros moubata* (Murr.) collected in the dormitories of a school at Itete in Tanganyika. All showed normal virulence for white mice, which is characterised by prolonged spirochaetaemia and easy transfer of infection by serial passage. Of 330 ticks collected in the dormitories in 1954 and examined for spirochaetes, 71 were infected. Injection of suspensions of the infected ticks, each into a pair of white mice, showed, however, that only two of the ticks contained normally virulent spirochaetes. Those in a third failed to infect one of the mice and produced a very light and temporary spirochaetaemia in the other, with failure of attempted passage, but those in the remaining 68 were completely non-virulent [*cf. R.A.E.*, B **44** 49]. An initially virulent strain of *B. duttoni* that was obtained in Itete in 1949 and was maintained in a Basle laboratory by hereditary transmission in ticks that were fed exclusively on healthy mice or rabbits had lost its virulence in the third filial generation of the latter. Since no new cases of relapsing fever had been seen in the school for several years before 1954, the Basle observation suggested that the loss of virulence for mice in the spirochaetes at Itete might be attributable to exclusively transovarian transmissions as a result of immunity in the human population. Further investigations were made on the characteristics of two of the strains that were not virulent to mice, including the one that had lost its virulence in the laboratory. They proved to be infective to rhesus monkeys [*Macaca mulatta*] or a human volunteer, but produced only mild symptoms of disease and a rather scanty spirochaetaemia in them. They multiplied only a little in lice (*Pediculus humanus humanus* L.), whereas mouse-virulent strains multiplied abundantly. When a tick harbouring one of them was superinfected with a virulent strain, the virulence of the latter was not affected.

Halff (L. A.). **Untersuchungen über die Abhängigkeit der Entwicklung der Reduviide** *Triatoma infestans* **Klug von ihrem Darmsymbionten.** [Investigations on the Dependence of Development in the Reduviid *T. infestans* on the Symbiont in its Gut.]—*Acta trop.* **13** no. 3 pp. 225–253, 8 figs., 51 refs. Basle, 1956. (With Summaries in English and French.)

Details are given of observations on a symbiotic bacterium found in the anterior part of the mid-gut of *Triatoma infestans* (Klug). It is concluded from them that it belongs to the genus *Nocardia*, and that its function in *T. infestans* is similar to that of *N. rhodnii* in *Rhodnius prolixus* Stål, in that it supplies a vitamin of the B complex necessary for the development of the bug [*cf. R.A.E.*, B **46** 35], in this case folic acid.

Laird (M.). **Wartime Collections of Insects from Aircraft at Whenuapai.**—*N.Z. J. Sci. Tech.* **38** (B) no. 2 pp. 76–84, 28 refs. Wellington, N.Z., 1956.

A list is given of about 100 species of insects, representing 49 families and ten orders, that were collected at Whenuapai Airport, New Zealand [*cf. R.A.E.*, B **41** 200] in 16 aircraft arriving from the New Hebrides, New Caledonia and Fiji during 1943–44. It shows the numbers of aircraft in which they were found and the islands from which they came, and is followed by brief notes on some of them. Those of medical or veterinary importance included six species of mosquitos of the genera *Aëdes*, *Culex* and *Mansonia*, as well as *Stomoxys calcitrans* (L.), various other flies, and cockroaches.

Lord (K. A.) & Solly (S. R. B.). **The Rate of Disappearance of Para-oxon from two Strains of Houseflies.**—*Chem. & Ind.* 1956 pp. 1352–1353, 3 refs. London, 1956.

One of the two strains of house-flies [*Musca domestica* L.] used in the work described was normally susceptible to paraoxon, and the other was about twice as resistant. Preliminary experiments failed to reveal any differences in the *in vitro* inhibition by paraoxon of the hydrolysis of acetylcholine, triacetin and phenyl acetate by extracts of the two strains. The residual paraoxon in females treated topically with 1 μl. of $3{\cdot}6 \times 10^{-4}$ M in acetone solution was then assayed after various intervals by its anticholinesterase activity, when dilutions of aqueous homogenates of the flies were incubated with an extract of an acetone powder of whole adult flies of the normal strain. Paraoxon was found to decrease rapidly and similarly in both strains. The loss was confirmed in further observations in which more concentrated solutions were used and detection was by paper chromatography. Two hours after flies had been treated with 2 μl. of $3{\cdot}6 \times 10^{-3}$ M paraoxon or p-nitrophenol, neither could be detected in them, though both could be detected earlier. Unchanged p-nitrophenol was found in the excreta of flies treated with p-nitrophenol, but no positive results were obtained with paraoxon.

No differences were detected between the strains apart from resistance to paraoxon. The rapidity of the loss of paraoxon from both strains suggests that it must not only penetrate the cuticle rapidly but also reach the site of action and produce an irreversible lesion quickly, as otherwise the flies would either not be affected or would recover after an initial inactivation. Since both strains have a highly active detoxification mechanism, it is possible that differences in localised rates of penetration or detoxification near the site of action may result in large changes of concentration of poison there without a correspondingly large change in the total amount of poison remaining in the insects as a whole. This could result in a difference in resistance to paraoxon without any apparent differences in *in vitro* enzyme inhibition or overall detoxification rate.

Keller (J. C.) & Gouck (H. K.). **Small-plot Tests for the Control of Chiggers.**—*J. econ. Ent.* **50** no. 2 pp. 141–143, 3 refs. Menasha, Wis., 1957.

Various promising acaricides were tested near Orlando, Florida, between 1947 and 1954 against *Trombicula* (*Eutrombicula*) *alfreddugèsi* (Oudm.) in woodland plots 5,445 sq. ft. in area and against *T. splendens* Ewing in plots of 2,500 sq. ft. along the grassy margins of lakes. Populations before and at various intervals after treatment were determined by exposing 6-inch squares of black oilcloth or plastic for one minute in 20 favourable sites on each plot, counting the mites that assembled and returning them to the plot. The effectiveness of the acaricides was assessed by the percentage reductions in populations after allowance for fluctuations in control plots, and the results for each compound and for various rates of application of many of them are given in tables. Against *T. alfreddugèsi*, sprays (all in emulsion form) were applied with a compressed-air sprayer, generally at 24 U.S. gals. per acre, and dusts with a rotary hand duster at 10–40 lb. per acre. Among some 20 materials tested, toxaphene and dieldrin were outstanding. Toxaphene had an effectiveness of over 90 for 14 weeks and over 80 for six weeks when applied in sprays at 2 and 1 lb., respectively, per acre, and over 90 for at least eight weeks, the duration of the experiment, as a dust at 5 lb. Dieldrin in sprays had an average effectiveness of about 90 for 14 weeks at 1 lb. and over 90 for four weeks at 0·5 lb. Against *T. splendens*, 13 acaricides were applied as emulsions and two as wettable-powder suspensions with a power sprayer at 100 U.S. gals. per acre. Endrin, which was used as an emulsion (and was not among the acaricides tested against *T. alfreddugèsi*) was much the most effective. It had an effectiveness of at least 99 for 14 weeks at 1 lb. per acre and 97–99 and 83–

98 for ten weeks at 0·5 and 0·2 lb. High degrees of effectiveness (over 90) at 1 lb. per acre were shown by dieldrin in wettable-powder suspensions and γ BHC (lindane) in emulsion for four weeks, when observations were discontinued, and by dieldrin in emulsion in all but the second of a sequence of eight weeks. BHC containing 36 per cent. γ isomer, which was tested at rates of only 0·5–0·1 lb. per acre was about as effective as lindane at the same rates. The other acaricides were less effective.

Moreland (C. R.) & McLeod (W. S.). **Studies on Rearing the House Fly on a Bran-Alfalfa Medium.**—*J. econ. Ent.* **50** no. 2 pp. 146–150, 18 refs. Menasha, Wis., 1957.

In the process of rearing house-flies [*Musca domestica* L.] for use in testing insecticides by the Peet-Grady method [*R.A.E.*, B **44** 25], the effects on yield of pupae of variations in the recommended procedures [**37** 89] were investigated. The rearing media were used at the rate of 382 g. dry ingredients per jar and the basic one, with which others were compared, comprised 382 g. of a 2:1 mixture of bran and lucerne meal, 7·5 g. yeast, 6·25 g. diastatic malt extract and 800 ml. water. Yields of pupae in weight and in numbers were uniform with this medium, but there were unexplained variations, particularly in yield by weight, with one in which the dry ingredients of the medium of the Chemical Specialties Manufacturers Association (stated to be lucerne meal, dried brewers' grains and soft-wheat bran in equal parts by weight) were used with the same amounts of yeast, malt and water. Differences between flies reared in the two media when results were most divergent were not, however, reflected in the results of Peet-Grady tests. The finding of other workers that the amount of water in the medium was important for the production of reproducible numbers and weights of pupae [*cf.* **41** 199] was confirmed. Too much water caused anaerobic putrefaction at the bottom of the medium, with consequent overcrowding of larvae in the upper layers, and too little water caused a grey, ashy central core to form, owing to excessive heat of fermentation. In both cases, the pupae were small. Variations in the amounts of yeast and malt used in the basic medium were of no significance within the limits tested (1·9–15 g.). In the absence of yeast and malt, however, yield was greatly reduced and the pupae were smaller. It was shown that a stock suspension of yeast and a stock solution of malt could be stored in a refrigerator at 5–6°C. [41–42·8°F.] and used over a period of four months.

The rate per jar at which the eggs were added was usually 0·3 ml. In a test in which rates of 0·1, 0·2, 0·3, 0·5 and 0·7 ml. were compared, the total numbers of pupae produced and (in brackets) the numbers per gramme in a 5-g. sample were, respectively, 837 (43·8), 1,568 (52), 2,091 (50), 2,957 (60·8) and 3,740 (71·4), and the development of the larvae was retarded at the higher rates of seeding. It was shown that there was a close agreement between the actual numbers of pupae per jar and the number estimated from their total weight and the number of pupae in a 5-g. sample. There was an increase in percentage emergence as the size of pupae increased. The smaller pupae were predominantly male and the larger female. Oviposition pads were usually left in the stock cage from 9 a.m. to 2 p.m., and the eggs were put into medium mixed the same day, but occasionally insufficient eggs were obtained. In this case, if eggs that had been laid during the following night were added to the medium that had been allowed to ferment for 18 hours, their development was accelerated and it was possible to maintain the normal testing schedule. The resulting adults were as suitable for evaluation of insecticides as those produced according to the standard rearing schedule. From 30 months' continuous rearing, representing 1,562 jars of medium, an average of 38·9 ± 4·4 g. pupae per jar was obtained, with an average of 48·1 ± 2 pupae per g. and a calculated total of 1,838 ± 220 pupae per jar.

Gersdorff (W. A.), Mitlin (N.) & Piquett (P. G.). **The relative Toxicity, synergistic Activity, and Knockdown Effectiveness of Mixtures of Piperonyl Butoxide with Allethrin and its *Trans* Fraction and Isomers as House Fly Sprays.**—*J. econ. Ent.* **50** no. 2 pp. 150–156, 6 refs. Menasha, Wis., 1957.

The following is largely based on the authors' summary. A comparative study was made of the toxicity and knockdown effectiveness of 10 : 1 mixtures of piperonyl butoxide with allethrin, its *trans* fraction and four *trans* stereoisomers [*cf. R.A.E.*, B **42** 135] when applied as space sprays in refined kerosene against house-flies (*Musca domestica* L.) on the Campbell turntable [**26** 246]. The mixtures with the *l*-allethrolone *d-trans* chrysanthemic acid ester, the *d-l*, *l-l* and *d-d* esters, the *dl-trans* fraction and allethrin, which was 95 per cent. pure, were, respectively, 1·93, 0·41, 0·029, 10·34, 3·86 and 3·03 times as toxic on the basis of the median lethal concentrations of their insecticide (ester) equivalents [*cf.* **41** 101] as allethrin alone. The first five in the same order were 0·64, 0·14, 0·01, 3·41 and 1·27 times as toxic as the allethrin mixture; except for the *l-l* ester, these are the same relationships as were found previously for the toxicants without piperonyl butoxide [*cf.* **42** 135]. Synergism with respect to mortality was shown to occur in all the mixtures. Its intensity was threefold at the 50 per cent. mortality level in all six mixtures. In the case of the mixture with the *l-l* isomer, this threefold intensity was indicated by deduction but could not be demonstrated experimentally, probably because of the relatively low toxicity of the isomer. This necessitated the use of relatively high concentrations of mixture, making a spray with large droplets that fell out rapidly so that the flies received less of this spray than of the others. Because of differences in slopes of the regression lines, the intensity of synergism varied from twofold to nearly fivefold between the 5 and 95 per cent. mortality levels. There was no synergistic action in any mixture with respect to knockdown in 25 minutes, but the mixtures showed about the same relative effectiveness in causing knockdown as in causing death. It is concluded that initial paralysis and death are not manifestations of distinct types of toxic action, but are phases of a single physiological reaction. In the mixtures, the intensity of the stimulus needed to cause a given mortality was about three times that needed to cause the same percentage knockdown in 25 minutes.

O'Brien (R. D.). **Properties and Metabolism in the Cockroach and Mouse of Malathion and Malaoxon.**—*J. econ. Ent.* **50** no. 2 pp. 159–164, 3 figs., 19 refs. Menasha, Wis., 1957.

Malathion (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorodithioate) is an insecticide of great interest because its toxicity to mammals is low, and insects do not develop resistance to it to the extent that they do to chlorinated hydrocarbons. Malaoxon (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorothiolate) is of interest as a probable metabolic product of malathion in both insects and mammals, and its production may account for the toxic effects of the latter [*cf. R.A.E.*, B **45** 77; **46** 47]. Its use as an insecticide and acaricide has also been suggested, as it lacks the odour of malathion. In the present paper, the results are given of studies on the properties and metabolism of malathion and malaoxon, and a mechanism for the selective toxicity of malathion is suggested on the basis of the data obtained.

The following is the author's summary. The stability, polarity, spectra and anticholinesterase activities of malathion and malaoxon are described. Evidence is given that malaoxon is a product of malathion metabolism in the cockroach [*Periplaneta americana* (L.)] and mouse. Mouse liver is shown to activate malathion, probably by oxidation to malaoxon, by means of a microsomal system requiring DPNH, Mg++ and nicotinamide. Although whole cockroach guts activate malathion, this property is lost on homogenization and only a little restored by addition of the above cofactors. In the mammal, malathion oxidation occurs primarily in the liver, and to a lesser extent in heart and perhaps testis. Malaoxon hydrolysis is vigorous in liver, kidney and lung. In the cockroach, fat body and midgut oxidise malathion; fat body hydrolyses malaoxon. The hydrolysing system of liver is in the soluble fraction, and is more active against malathion than malaoxon. The balance of oxidative (activating) and hydrolytic (degrading) activities in the mouse and cockroach accounts satisfactorily for the much greater toxicity of malathion for the cockroach than for the mouse.

GERSDORFF (W. A.) & PIQUETT (P. G.). **Comparative Effects of Piperettine in Pyrethrum and Allethrin Mixtures as House Fly Sprays.**—*J. econ. Ent.* **50** no. 2 pp. 164–166, 6 refs. Menasha, Wis., 1957.

The isolation, identification and synthesis of a compound that they named "piperettine" were recorded by F. S. Spring & J. Stark in 1950. It was isolated from extracts of *Piper nigrum* from which piperine had been removed and was identified as the vinyl analogue of piperine. Because piperine has been found to be highly synergistic with pyrethrins [*R.A.E.*, B **39** 42], a sample of piperettine extracted from *P. nigrum* and purified was examined for synergism with pyrethrins and with allethrin. Stock solutions were prepared by dissolving the insecticides in refined kerosene and the piperettine in refined kerosene and 10 per cent. acetone by volume. This proportion of acetone was maintained in the diluted mixtures. Except in one spray in the preliminary tests, piperettine and insecticide were mixed in the proportion of 10:1. The sprays were tested on house-flies (*Musca domestica* L.) by the Campbell turntable method [**26** 246]. Piperettine alone at 200 mg. per dl. caused no knockdown of flies in 25 minutes and no mortality. All sprays containing the insecticides caused complete knockdown. The LC50 of pyrethrins was 235·7 mg. per dl. and that of the mixture was 14·46 mg. pyrethrins and 144·6 mg. piperettine. Adjustment of the figures to allow for the apparent increase in toxicity attributable to the presence of acetone [**46** 23–24] in the mixture showed that it was 13·7 times as toxic as pyrethrins alone. This makes piperettine, as appraised by the turntable method, equal to the best commercial synergists with pyrethrins [*cf.* **40** 59; **41** 101; **44** 19]. With allethrin, however, its synergism was extremely low, the mixture being only 1·15 times as toxic as allethrin alone.

ADKINS jr. (T. R.) & ARANT (F. S.). **Systemic Effect of Dipterex on the Bed Bug and Gulf Coast Tick when administered to Rabbits.**—*J. econ. Ent.* **50** no. 2 pp. 166–168, 1 graph, 3 refs. Menasha, Wis., 1957.

In continuation of previous experiments [*R.A.E.*, B **44** 51], water solutions of Bayer L 13/59 (Dipterex) [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] were administered orally to rabbits, and fifth-instar nymphs of the bed-bug (*Cimex lectularius* L.) or nymphs of the Gulf Coast tick (*Amblyomma maculatum* Koch) were fed on them. Percentage mortalities in six days of bed-bug nymphs that had fed on rabbits receiving 0, 10, 20, 30 and 40 mg. per kg. body weight were 0, 36·3, 74·5, 83·9 and 97·8, respectively. Some of the bugs began to feed one hour and some two hours after the rabbits had received the chemical, but as the results did not differ significantly, they are pooled. Percentage mortalities of ticks were 0, 25·2, 88·3, 95·5 and 100 on rabbits receiving 0, 25, 50, 75 and 100 mg. per kg. The ticks were put with the rabbits two days before the latter received the L 13/59, and results are based on mortality at dropping time of those that attached themselves. The dosages per kg. body weight of the host required for 50 per cent. mortality of the bugs and ticks were estimated to be 14 mg. and 36 mg.

Gouck (H. K.), Hall (S. A.), Smith (C. N.) & Gilbert (I. H.). **Repellency of Homologous Series of Cyclohexane Aliphatic Acids and Amides.**— *J. econ. Ent.* **50** no. 2 pp. 175–177, 1 fig. Menasha, Wis., 1957.

Preliminary tests with mosquito repellents, in which the criterion of effectiveness was the number of days for which a treated cotton stocking would protect a man's arm in a cage of mosquitos, indicated that the effectiveness of a homologous series of cyclohexane aliphatic acids (carboxylic to hexanoic) increased with the number of carbons in the structural chain up to a certain length and then decreased. Additional tests were carried out to determine whether the more effective compounds had a higher initial repellency or were retained longer on the stockings or both. A series of four of the corresponding amides was also examined. Acetone solutions of the repellents were applied to an area of 0·3 sq. ft. on cotton stockings, from which the solvent was allowed to evaporate. They were tested after various intervals by being drawn over an arm, which was then exposed in a cage containing 2,000 adults of *Aëdes aegypti* (L.) four days old. Exposure was continued for one minute or until more than ten mosquitos had bitten through the stocking if this occurred first. Tests of initial repellency, in which the minimum effective dosage (the minimum dosage that reduced the average number of bites per minute to less than one) was determined two hours after treatment, showed that increasing the length of the chain by inserting 1–3 carbons progressively increased the initial effectiveness of the repellent, but adding 4 or 5 carbons decreased it. Minimum effective dosages were 0·25, 0·2, 0·15 and 0·1 g. for the cyclohexanecarboxylic, acetic, propionic and butyric acids, respectively; but the cyclohexanevaleric and hexanoic acids did not provide this degree of protection at any dosage tested, of which the highest was 2 g. The duration of effectiveness at equivalent dosages also increased with length of chain up to a certain point. At twice the minimum effective dosages, the first four acids gave protection against one bite and (in brackets) ten bites per minute for average periods of 1 (1·67), 2 (3), 3·67 (5·67) and 1 (9·33) days, respectively. The fifth and sixth again gave no protection against one bite, but the fifth gave very variable results against ten. The sixth gave only extremely short protection against ten bites even at the highest dosage. The overall increase in practical effectiveness of the best repellents was thus shown to be due to a combination of greater initial effectiveness and better retention of the repellent.

Similar tests with the N,N-diethylamides of the first four cyclohexane aliphatic acids showed that extending the length of the chain by adding one carbon increased initial repellency, but adding two and three carbons caused a progressive decrease. The minimum effective dosages were 0·25 g. for the carboxamide and acetamide and 0·5 g. for the proprionamide, but the first allowed 6·3 bites and the second 1·3 at 0·125 g. The butyramide did not provide initial protection at any dosage tested (up to 0·5 g.). The average periods in days for which the four amides gave protection against one and (in brackets) ten bites per minute when they were applied at 0·5 g. were 1 (1), 3 (5·3), 1·3 (11) and 0 (0·33).

JARVIS jr. (F. E.), GRAYSON (J. M.) & LEVITAN (M.). **Further Evidence for Autosomal, Multiple-Factor Inheritance of Chlordane Resistance in the German Cockroach.**—*J. econ. Ent.* **50** no. 2 pp. 185–187, 2 graphs, 8 refs. Menasha, Wis., 1957.

The following is substantially the authors' summary. Further information on the inheritance of resistance to chlordane in *Blattella germanica* (L.) [*cf. R.A.E.*, B **45** 43] was obtained by determining the order of resistance of the F_2 progeny of reciprocal crosses between chlordane-resistant and normally susceptible strains, the progeny of pair matings within strains, and cockroaches in successive generations of a chlordane-resistant strain in which selection was discontinued. Toxicity was tested by dipping adults in aqueous suspensions of chlordane at different concentrations and observing mortality up to ten days. The data obtained are given in the form of log-probit regression lines and as indices of resistance.

The results indicate that many loci are involved in the transmission of resistance to chlordane in *B. germanica* [*cf.* **45** 213]. They also substantiate previous indications [**45** 43] that chlordane-resistance is transmitted by the autosomes, with no evidence of maternal factors or sex-linked inheritance. Some of the evidence suggests that resistance factors exerting some form of dominance might be present.

PFADT (R. E.) & DEFOLIART (G. R.). **Power Dusting to control the Sheep Ked.**—*J. econ. Ent.* **50** no. 2 pp. 190–194, 1 fig., 4 refs. Menasha, Wis., 1957.

Treatment of range sheep for the control of ked (*Melophagus ovinus* (L.)) in the western United States is difficult because of the climate and the very large numbers involved, which make dipping or spraying hazardous, laborious, and costly. A dust containing 5 per cent. rotenone, applied to one flock by a power-dusting method [*R.A.E.*, B **34** 163], reduced infestations considerably but did not eradicate them. Nine dusts were therefore compared in an endeavour to find one that would be completely effective. These were 1 and 1·5 per cent. dieldrin, 5 per cent. chlordane, 5 per cent. toxaphene, 1 per cent. heptachlor, 1 per cent. γ BHC (lindane), 0·5 per cent. rotenone and combinations of 0·5 per cent. rotenone with BHC to give 0·25 per cent. γ isomer or with 10 per cent. of a thiocyanate preparation (Lethane 60). Initial tests were made on farm flocks of about 60 breeding ewes, and the most effective dusts were then tried on range flocks. Pyrophyllite was the chief diluent used, as it produces light curtains of dust through which the sheep will pass readily, and the addition of 2 per cent. light motor oil further reduced fluffiness. Sheep passed through an eight-nozzle chute at about 30 per minute or more, and 50–100 lb. dust treated 1,000 sheep. Results were assessed by counting keds on some of the sheep immediately before treatment and 1, 3 and 6 weeks after it, and sheep from untreated flocks were similarly examined as controls in some of the tests. Two farm flocks were also examined monthly for three years to determine seasonal fluctuations in ked populations. This showed that populations decreased in summer, but no infestation ever disappeared completely.

In experiments in which the dusts were applied to shorn sheep in spring, the most effective was 1·5 per cent. dieldrin, which eradicated the ked within six weeks from all of the nine flocks to which one application was made at 2·4–3·3 lb. per minute. Four of the flocks were re-examined in the autumn and were still uninfested. One application of 1 per cent. dieldrin eradicated infestation in six weeks from three flocks treated at 2·8–3·6 lb. per minute but not from three others treated at 1·2–2·8 lb. No examination was made in autumn. Chlordane and toxaphene eradicated infestations from one out of three flocks and one out of six, treated at 2·3–2·9 and 2·5–3·7 lb. per minute, respectively. In each case, eradication was from the flock treated at the highest rate. No other dust eliminated infestation. Dusting twice with 1 per cent. dieldrin (2·3–2·8 lb. per minute) or with toxaphene (2·1–2·9 lb. per minute) or chlordane (2·8–3·7 lb. per minute) at intervals of 2, 3, or 4 weeks in spring after shearing eradicated infestation in three or six weeks after the last treatment, except in the case of the lowest rate of application with toxaphene. Dusting three flocks twice with rotenone at 2·1–2·6 lb. per minute did not eradicate any infestation.

When sheep from range flocks treated in spring with 1·5 per cent. dieldrin were kept in an unfenced area where they had access to untreated flocks, the treated flocks had 99 per cent. fewer keds than untreated ones in the autumn, and ewes and yearlings in treated flocks had 85 and 72 per cent. fewer keds than those in untreated ones in the following spring. The amount of dieldrin applied to the sheep by this method is safe for the animals and does not result in the deposition of amounts unsafe for consumers of lamb or mutton or users of the wool [**44** 55]. Attention is drawn to some practical details to which attention should be given if dusting is to be as successful as possible.

Tests of power dusting of farm and range flocks in the autumn with 1 or 1·5 per cent. dieldrin, 5 per cent. toxaphene or the mixture of rotenone and BHC indicated that eradication could not be effected with these materials at this season, but dusting lambs on feed in the autumn with either 0·5 per cent. rotenone or 1 per cent. dieldrin reduced infestations by 90–91 per cent. three weeks after treatment. Although experiments have failed to show any benefit from dusting lambs on feed [**41** 73, 139], some stockmen believe from personal experience that dusting is profitable when lambs are thin and heavily infested. If it is desired to dust in these circumstances, 0·5 per cent. rotenone, pyrophyllite and 2 per cent. light motor oil is best, when both effectiveness and absence of toxic residues are taken into account.

Languillon (J.), Mouchet (J.), Rivola (E.) & Rateau (J.). **Contribution à l'étude de l'épidémiologie du paludisme dans la région forestière du Cameroun. Paludométrie, espèces plasmodiales, anophélisme, transmission.**—*Méd. trop.* **16** no. 3 pp. 347–378. 2 graphs, 2 maps. 29 refs. Marseilles, 1956. (With a Summary in English.)

The forest region (southern part) of the French Cameroons and its climate and population are described, and the results are given of a malaria survey in which children 2–9 years old in eight different areas, and some infants and adults were examined. These showed that malaria is holoendemic throughout the region, except in the Yaoundé area, which has been greatly changed by human influence, and the Moloundou area, which is sparsely populated. In these areas, it is mesoendemic. *Plasmodium falciparum*, *P. malariae* and *P. ovale* were found in 53·8, 6·7 and 0·65 per cent., respectively, of the children examined.

An Anopheline survey, in which mosquitos were caught in dwellings by day, mainly in the early morning, was carried out at the same time as the malaria survey, and the results were completed by those of more detailed investigations near Yaoundé [*cf. R.A.E.*, B **46** 60, 62]. It was found that *Anopheles gambiae* Giles is present and infected throughout the area, and is on this account the principal malaria vector, though it seemed to be less abundant than it is in the savannah regions to the north. Observations in the villages round Yaoundé showed that its behaviour differs considerably from one locality to another. It bites out of doors to a considerable extent in some places and hardly at all in others, and in some places it apparently bites indoors and goes outside to rest, though the outdoor resting places were not found [*cf.* **46** 63]. It uses a wide variety of breeding places, including both natural and man-made sites. *A. moucheti* Evans is the second most important vector. It rests indoors, and its density per hut and infection rate are locally high, but it is found only near large and medium-sized streams, in which it breeds [*cf.* **46** 63]. It bites out of doors in the evening. *A. nili* (Theo.), which is widely but sporadically distributed and only occasionally endophilous, and *A. funestus* Giles have both been found infected in the region, but seem to be of minor importance, and *A. hancocki* Edw. is often endophilous, but is not known to be a vector. Ten other species of *Anopheles* were found, but they did not seem to play any important part in malaria transmission.

TAUFFLIEB (R.). **Rapport sur la campagne antisimulidienne de 1956 au Mayo-Kebbi.**—*Bull. Inst. centrafr.* (N. S.) no. 11 pp. 53–59, 1 map. Brazzaville, 1956.

Simulium damnosum Theo. apparently disappeared from the Mayo Kebbi, in French Equatorial Africa, as a result of measures taken for its control in February and March 1955 [*R.A.E.*, B **45** 49–50], but an inspection in the second half of July, two months after the onset of the rainy season, revealed the presence of adults in each of the three treated sections. The numbers of bites received per hour were 30, 30 and 3, as against 33, 400 and 38. respectively, before treatment in February. Reinfestation appeared to have originated at the upstream end of the treated stretch of river and was certainly not due to infiltration from another focus. Possible explanations are aestivation of the females far from their usual resting and oviposition sites, a repellent effect of the insecticide causing the adults to retreat to some distance, and inadequate treatment with the larvicide owing to the use of too few points of application. Resistance of the eggs to drying for several months was considered most unlikely.

Further measures against the adults were not taken on account of expense, but the larvicide was applied at more points and over a longer period in the following dry season. No larvae or pupae of *S. damnosum* were found in February 1956 in the part of the river above the stretch treated in 1955, but they were numerous in the three sections of this stretch, and 20, 100 and 50 bites per hour were received. Nine weekly applications of the larvicide were made at five points (one of them about three miles upstream of the part of the river in which the larvae were found) from 25th February to 22nd April at a rate to give 3 parts γ BHC per million for a minute at each point. None of the pupae of *S. damnosum* collected after the first application gave rise to adults, but data on the effectiveness of subsequent ones were not available to the author, who left the area before the third was begun.

RETIREMENT OF DR. W. J. HALL, C.M.G., M.C.

The retirement in June of Dr. W. J. Hall, Director of the Commonwealth Institute of Entomology since 1946, will be greatly regretted by the Executive Council and the Staff of the Institute, as well as by entomologists throughout the world, many of whom, especially in the Commonwealth, will remember with gratitude his personal help or advice.

Dr. Hall joined the staff as Assistant Director in 1943, after 23 years in Africa, both in Egypt, where he was Senior Entomologist to the Ministry of Agriculture, and later in Southern Rhodesia, where he had charge of the Citrus Estates and Experimental Station of the British South Africa Company. He thus brought to the service of the Institute not only an authoritative knowledge of the scale insects, but also a long experience overseas of entomological research and its applications, and a thorough understanding of the problems and needs of the man in the field.

His twelve years' tenure of office as Director has covered both the difficult period immediately after the war and the immense expansion of applied entomology that followed, including the developments in the field of insecticides that have virtually transformed the subject. Under his guidance, the Institute has kept abreast of these advances and has been able to fulfil the greatly increased demands made upon it. The circulation of its publications, which is one measure of its health, and which had regained the prewar level by 1946, has since then been doubled. Dr. Hall's foresight has enabled the Institute to acquire as its permanent home the building at 56, Queen's Gate.

In recent years, a very large programme of research has been initiated in the Colonies under the stimulus of the Colonial Development and Welfare Acts, and this has resulted in heavy additional demands on Dr. Hall for advice on entomological matters. He has been a member of the Colonial Research Council since 1950, when he became Chairman of the then Colonial Insecticides Committee, of which he had been a member from its inception in 1947, and he has served on numerous other committees dealing with entomological problems overseas. He has also been closely concerned in the creation of the Colonial Pool of Entomologists and the Colonial Termite Research Unit, both of which are attached to the Institute and link it directly with work in the field, and in another important development, whereby the Institute acts as a centre of entomological information for the Inter-African Phytosanitary Commission.

Dr. Hall has never spared himself in the discharge of his manifold responsibilities, and he has sustained his burdens with a good sense and confidence that have won him the admiration and respect of all who have been associated with him. He takes with him the warmest good wishes of everyone in his retirement.

Dr. Hall is succeeded by Mr. E. O. Pearson, who joined the staff of the Institute as Assistant Director in 1953, after 22 years' experience in Africa. Mr. R. G. Fennah, who has served for 24 years in the West Indies, has been selected for the post of Assistant Director and will take up his appointment shortly.

T. SWAMINATHAN, I.C.S.

Chairman of the Executive Council of the
Commonwealth Agricultural Bureaux.

June, 1958.

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Pringle (G.). **Kala Azar in Iraq: preliminary Epidemiological Considerations.**—*Bull. endemic Dis.* **1** no. 4 pp. 275–294, 1 map, 23 refs. Baghdad, 1956.

In 1953–55, 24 cases of visceral leishmaniasis (kala-azar), almost all in children, were reported from Iraq. They occurred singly and sporadically, mostly in isolated rural communities in the dryer tracts of the plains and appeared to be autochthonous. No infection with *Leishmania donovani* was found in dogs, and it is suggested that jackals or other wild animals may be the local reservoirs. Data are given on sandflies (*Phlebotomus*) collected in the plains and the Zagros mountains. The eight species taken in the mountains included *P.* (*P.*) *wenyoni* Adl. & Thdr., and *P.* (*P.*) *kandelakii* Shchurenkova (both members of the group of *P. major* Annan.) and a variety of *P.* (*P.*) *chinensis* Newst. The *major* and *chinensis* groups are normally associated with the transmission of *L. donovani*, but only one case of kala-azar was reported from the mountains. The nine species taken in the plains did not include any members of these groups, and the only species known or likely to bite man (with the numbers taken) were *P.* (*P.*) *papatasi* (Scop.) (1,692), *P.* (*P.*) *sergenti* Parr. (15), *P.* (*P.*) *alexandri* Sinton (26) and *P.* (*Sergentomyia*) *clydei* Sinton (6). The potentially important *P. clydei* [*cf. R.A.E.*, B **45** 33, etc.], like *P. kandelakii* and *P. chinensis* is recorded from Iraq for the first time. *P. sergenti* is thought to be the only vector of dermal leishmaniasis (*L. tropica*) in Iraq [**41** 40], where this disease occurs in densely populated parts of Baghdad and Mosul, but it is unlikely to be the vector of the sporadically distributed kala-azar. The literature on the relation of *P. papatasi* to *L. donovani*, which is reviewed, suggests that it is relatively unsuited to act as a vector in the Mediterranean basin and the Sudan [*cf.* **19** 121; **38** 77, 172] but that it may be the most important one in Soviet central Asia. *P. clydei* seems to be rare or very local in Iraq.

Abul-Hab (J. K.). **Observations on the Overwintering of** *A. sacharovi* **(Anophelini, Culicidae) in Suleimaniya Liwa, northern Iraq.**—*Bull. endemic Dis.* **1** no. 4 pp. 298–310, 4 graphs, 4 refs. Baghdad, 1956.

Observations made in Suleimaniya, northern Iraq, from December to May in 1952–53 and October to May in 1953–54 and 1954–55 showed that *Anopheles maculipennis sacharovi* Favr does not hibernate completely, though its activity is considerably reduced in winter and it tends to congregate in inhabited rooms [*cf. R.A.E.*, B **34** 202]. Monthly temperatures were low (about 40–50°F.) from December to March, and lower in the first two seasons than the third, but a considerable proportion of the females had ovaries developed beyond stage II [**29** 93] except in November and December. About a third of those examined showed evidence of having taken a blood-meal in November, December and January and more in the other months. The percentage of females with a developed fat-body was high from October to February, began to decrease in March and had fallen to less than 10 in April. The onset and cessation of gonotrophic dissociation did not appear to be regulated primarily by temperature. It is thought that there is little malaria transmission in winter in Suleimaniya but that sporadic instances occur. Indoor winter temperatures are probably generally too low to allow the parasite to develop in the mosquito.

Baker (J. R.). **A new Vector of** *Haemoproteus columbae* **in England.**—*J. Protozool.* **4** pp. 204–208, 5 figs., 16 refs. Utica, N. Y., 1957.

The only known vectors of *Haemoproteus columbae* are *Pseudolynchia canariensis* (Macq.) (*Lynchia maura* (Big.)) [*R.A.E.*, B **15** 234, etc.] and possibly *Microlynchia pusilla* (Speis.) which H. de B. Aragão reported to be a vector in 1916 without offering supporting experimental evidence. No indigenous vector of any species of *Haemoproteus* has been incriminated in Britain, where *P. canariensis* does not occur. The finding of pigmented ookinetes in the mid-gut of an individual of *Ornithomyia avicularia* (L.) collected on a captive wood-pigeon (*Columba palumbus*) in a London laboratory is therefore of interest. The wood-pigeon was known to be infected with *H. columbae* and less heavily with *Leucocytozoon marchouxi*, and the presence of pigment showed that the ookinetes could not be derived from the latter. The stages of the parasites found in the blood of the wood-pigeon and in *O. avicularia* are described. The stages observed in the fly closely resembled those described by Adie in *P. canariensis* [**12** 170], and included sporozoites that reached the salivary glands [*cf.* **38** 17]. Six attempts made in 1954 and 1955 to transmit *H. columbae* from the infected wood-pigeon to uninfected domestic pigeons (*C. livia*) by the bite of *O. avicularia* and in one case also by injecting intramuscularly a macerated and presumably infective fly, were unsuccessful.

KURTPINAR (H.). **Anadoluda, *Argas reflexus* Fabr. (güvercin kenesi) nin insanlarda tevlit ettiği sıhhi bozukluklar üzerinde araştırmalar.** [Investigations on Injury to the Health of Man caused by *A. reflexus* (Pigeon Tick) in Anatolia.]—*Turk. Bull. Hyg. exp. Biol.* **17** no. 3 pp. 237–243, 3 figs., 17 refs. Ankara, 1957. (With a Summary in English.)

Between 1953 and 1956, persons sleeping in dormitories in northern Turkey were bitten by *Argas reflexus* (F.), the adults of which are described; 22 such cases were reported, and the effects were in some cases severe, including not only local skin reactions but also shortness of breath, palpitations and high temperatures. Most of the bites were on the hands and feet. Adult ticks were numerous on the walls of the dormitories, which were situated below attics frequented by pigeons. A copious spray of BHC afforded control.

NORRIS (K. R.) & STONE (B. F.). **Toxaphene-resistant Cattle Ticks (*Boophilus microplus* (Canestrini)) occurring in Queensland.**—*Aust. J. agric. Res.* **7** no. 3 pp. 211–226, 18 refs. Melbourne, 1956.

It has often been observed that selection of a resistant strain of an organism by exposure to one toxicant increases its resistance to others, and evidence has been produced that BHC-resistant strains of *Boophilus decoloratus* (Koch) on cattle in South Africa have some resistance to toxaphene [*R.A.E.*, B **40** 108; **42** 22]. Laboratory experiments have also indicated resistance to toxaphene in BHC-resistant strains of *B. annulatus microplus* (Can.) in Queensland [**42** 79], but there has hitherto been little evidence of such resistance in the field. In September 1954, however, dipping cattle in a concrete vat charged with 0·5 per cent. w/v toxaphene did not control the tick on four herds near Beaudesert in southern Queensland, though it did so successfully on a fifth herd from a property 12 miles away. This herd had previously been treated with arsenic only until 1953, when a small amount of DDT was added to the dip. At Beaudesert, arsenic had become unsatisfactory in 1949, and BHC was used to charge the vat early in 1950. It gave good control for 18 months but not thereafter. DDT was satisfactory for a year before the vat was charged with toxaphene. The toxaphene dip had little or no effect in preventing reinfestation of the herds near Beaudesert, whereas one 25 miles away, which had not previously been exposed to chlorinated hydrocarbons and was dipped in June 1954 in a local vat that had been charged with 0·5 per cent. toxaphene five months before was protected from reinfestation for at least three weeks.

Concentration-response tests in the laboratory on F_2 offspring of ticks from one of the four Beaudesert herds indicated that the LD50 of toxaphene for engorged females was 19 times as high as that for a reference strain, and the LD50 for the larvae was also significantly higher. Ticks were not affected when the cows of this herd were sprayed with 0·05 per cent. w/v γ BHC. This was consistent with the earlier history of BHC resistance in the ticks on these herds. Spraying trials indicated no marked resistance to arsenic in the ticks; mortality following spraying with 0·5 per cent. w/v p,p′DDT was as high and the protective period against reinfestation by larvae was as long as those usually observed in other *microplus* populations; and a very high kill resulted from spraying with 0·05 per cent. w/v diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate]. The susceptibility of the ticks to DDT was confirmed in February 1955, when it was used instead of toxaphene in the Beaudesert vat and gave excellent control. Subcutaneous injections of cows with γ BHC (lindane), dieldrin and aldrin in groundnut oil at the rate of 25 mg. per kg. body weight had no effect on the toxaphene-resistant ticks, though unpublished work by W. S. Roulston has indicated that considerable protection would have been afforded against establishment of larvae of a normally susceptible strain.

Snowball (G. J.). **The Effect of Self-licking by Cattle on Infestations of Cattle Tick,** *Boophilus microplus* **(Canestrini).**—*Aust. J. agric. Res.* **7** no. 3 pp. 227–232, 9 refs. Melbourne, 1956.

The following is virtually the author's summary. Infestations of *Boophilus annulatus microplus* (Can.) were established by applying single batches of larvae to individually stalled cattle, and the percentage yields of engorged female ticks from animals kept in harness to impede licking were compared with those from animals allowed to lick freely. In the harness trials, 33 per cent. of female ticks survived to fall as engorged adults from the host; in individual infestations, this survival ranged from 5 to 69 per cent. In the trials without harness, the corresponding survival was 9 per cent., ranging from 0·1 to 32 per cent. Statistical analysis showed a highly significant effect of harness in promoting survival of ticks. Licking (and other forms of host behaviour, *e.g.*, kicking and rubbing, which kill ticks by mechanical means) must be considered in any study of natural mechanisms regulating cattle-tick populations.

Roth (A. R.) & Eddy (G. W.). **Tests with Dow ET-57 against Cattle Grubs in Oregon.**—*J. econ. Ent.* **50** no. 3 pp. 244–246, 9 refs. Menasha, Wis., 1957.

McGregor (W. S.) & Bushland (R. C.). **Tests with Dow ET-57 against two Species of Cattle Grubs.**—*T. c.* pp. 246–249, 4 refs.

Details are given in these two papers of experiments in 1955 and 1956 on the effectiveness of Dow ET-57 [purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] administered to cattle as a systemic insecticide for the control of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.). Some of the results have been noticed from a briefer source [*R.A.E.*, B **46** 54].

The tests carried out in Oregon are described in the first paper. When administered either orally in a capsule or subcutaneously in solution, at dosages varying from 10 to 200 mg. per kg. body weight, ET-57 gave very variable results against encysted second- and third-instar larvae of both species. Differences in effectiveness are thought to have been attributable mainly to differences in the age of larvae and possibly their numbers also.

The results indicated that complete kills of larvae that are within two weeks of emergence cannot be expected. Three herds were used in the test of oral administration of ET-57 in December 1955 before larvae had appeared in the backs of the cattle. One of these herds was infested principally by *H. lineatum*, and larvae subsequently appeared in the backs of five out of eight animals treated at 100 mg., in seven out of eight treated at 50 mg. and in all five controls, the average numbers per animal being 3·5, 19·8 and 37·9. The other two herds were lightly infested, one by *H. bovis* and the other by both species, and no larvae encysted in the backs of the animals treated at 100 mg. whereas fair numbers appeared in those receiving lower dosages and the controls. In the few spray tests, which involved cattle infested by *H. bovis* only, all encysted larvae were killed by a 2·5 per cent. emulsified solution applied at 2 U.S. quarts per animal, but only about 50 per cent. by a 1 per cent. wettable-powder suspension applied at 3 U.S. quarts and none by a 1 per cent. emulsified solution applied at 2 U.S. quarts.

The second paper contains an account of the work in Texas. In laboratory tests, ET-57 was toxic to larvae of *Callitroga hominivorax* (Coq.) and adults of *Stomoxys calcitrans* (L.) feeding on guineapigs that had received an oral or subcutaneous dose of 100 mg. per kg. It was less effective at 50 mg. and ineffective at 25 mg. In the experiment with the South Dakota cattle, 20 animals naturally infested by *H. bovis* and *H. lineatum* received 100 mg. ET-57 per kg. administered orally in an emulsified solution and 15 were similarly treated with the same dosage as a suspension. The average numbers of larvae that survived per treated and control animal were 1·6 and 57·9, respectively, indicating an average mortality due to treatment of 97·2 per cent. There was little difference between the results with the emulsion and the suspension.

RADELEFF (R. D.) & WOODARD (G. T.). **Toxicological Studies of Dow ET-57 in Cattle and Sheep.**—*J. econ. Ent.* **50** no. 3 pp. 249–251, 4 refs. Menasha, Wis., 1957.

To determine the acute toxicological hazard involved in the use of Dow ET-57 [purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] as a systemic insecticide for livestock [*cf.* preceding abstract], the compound as a suspension of a 25 per cent. wettable powder was administered orally to 254 cattle of various ages and a few sheep at dosages ranging from 100 to 400 mg. per kg. body weight. Mild symptoms of poisoning were observed in cattle that received 125 mg. per kg. and progressively severer symptoms as the dosage was increased to 400 mg. One sheep that received 400 mg. showed mild diarrhoea. The early symptoms were similar to those caused by chlorinated phenols (muscular weakness, incoordination, prostration and diarrhoea) and were followed by others characteristic of organic phosphorus insecticides. Occasionally there was salivation and dyspnoea, and the higher dosages caused severe loss of weight. Cholinesterase was depressed progressively over a period of 6–8 days, and recovered only at the rate of about 1 per cent. per day. Some cattle receiving 400 mg. per kg. had not returned completely to normal after 100 days, but no deaths occurred at any of the dosages used. There is evidently a great difference between the minimum toxic and minimum lethal dose.

HUNTER III (G. W.), PHILIPS (F. M.), GRIFFO jr. (J. V.) & WILLIAMS (J. S.). **Plot Tests of potential Acaricides at Camp Bullis, Texas, in 1954.**—*J. econ. Ent.* **50** no. 3 pp. 262–263, 5 refs. Menasha, Wis., 1957.

Dieldrin was the most effective of several acaricides tested in dusts against *Amblyomma americanum* (L.) at Camp Bullis, Texas, in 1952 [*R.A.E.*, B

42 188], and was the only one that gave satisfactory results in 1953, when it was compared with dusts of Sulphenone [p-chlorophenyl phenyl sulphone], Neotran [di(p-chlorophenoxy) methane], heptachlor, N-butylacetanilide and DDT and reduced the numbers of ticks by 96 and 98 per cent. in 48 hours and 98 and 97 per cent. after four weeks at 0·5 and 1 lb. per acre, respectively. In 1954, it was tested at 0·25 and 0·5 lb. per acre both as a dust and as a spray in comparison with endrin at 0·5 and 1 lb. as a spray and toxaphene at 1 and 2 lb. as a dust. The dusts were diluted with pyrophyllite and sprays were emulsified xylene solutions. The percentages by which the numbers of ticks were reduced after 48 hours and (in brackets) four weeks were 83·3 (94·1) and 69·6 (94) by toxaphene at 2 and 1 lb. per acre, 89·4 (94·4) and 95·5 (89·3) by dieldrin dust at 0·5 and 0·25 lb., 93 (100) and 92·9 (97·6) by dieldrin spray at the same rates, and 95·3 (100) and 96·7 (100) by endrin spray at 1 and 0·5 lb. Endrin gave better knockdown in 24 hours than dieldrin. It is not known why the dieldrin dust at 0·5 lb. was less effective than it had been in 1952 and 1953, but it is concluded from the results in the three years that, in a hot dry environment such as is found at Camp Bullis, dieldrin dust at 0·5 or 1 lb. per acre, dieldrin spray at 0·5 lb. or endrin spray at 1 lb. will probably reduce populations of *A. americanum* by 96 per cent. or more within 48 hours and maintain the reduction for four weeks.

FROST (S. W.). **The Pennsylvania Insect Light Trap.**—*J. econ. Ent.* **50** no. 3 pp. 287–292, 7 figs., 2 refs. Menasha, Wis., 1957.

The experiments described in this paper [*R.A.E.*, A **46** 223] include a series made to compare the effectiveness of the Pennsylvania trap, which emits ultraviolet light from a 15-watt black-light fluorescent tube lamp, with that of a New Jersey suction light-trap [*cf.* B **23** 151] equipped with a 100-watt inside-frosted tungsten lamp. The Pennsylvania trap was the more effective for most kinds of insects, but the New Jersey trap was considerably the more effective for mosquitos and Tipulids. The difference was apparently due to the difference between the white and ultraviolet light and not to the effect of the suction element of the New Jersey trap on weak flying insects, since the catch of Aphids in it was only about 12 per cent. of that in the Pennsylvania trap.

GRANETT (P.) & HANSENS (E. J.). **Further Observations on the Effect of Biting Fly Control on Milk Production on Cattle.**—*J. econ. Ent.* **50** no. 3 pp. 332–336, 1 ref. Menasha, Wis., 1957.

Experiments on two farms in south-western New Jersey in 1955 having indicated that control of biting flies on dairy cattle increases milk production [*R.A.E.*, B **45** 142], tests on a larger scale were made in 1956. Flies, including *Stomoxys calcitrans* (L.), *Siphona irritans* (L.) and Tabanids were generally less numerous than in the previous year, but *S. irritans* was plentiful early in the season. In addition to the flies, mosquitos (*Culex* spp. and *Aëdes* spp.) were troublesome. Tests were made on four farms. At each, the cows were divided into three groups, one (A) treated with methoxy-DDT (methoxychlor), a second (B) with methoxy-DDT and butoxy polypropylene glycol and a third (C) left untreated. Numbers of biting flies on individual cows were observed daily from Monday to Friday each week, and milk production was recorded every day. Water-emulsion sprays containing 0·5 per cent. methoxy-DDT with or without 5 per cent. butoxy polypropylene glycol were applied once a week on two farms, and twice a week on a third at 1 U.S. quart per cow. On the fourth farm, wettable powders containing 50 per cent. methoxy-DDT alone and with 10 per cent. butoxy polypropylene glycol were applied weekly for four weeks as dusts at 7·6 gm. per animal and, after an interval of two weeks, weekly for four weeks as sprays at 1 U.S. quart per animal of a suspension of 8 lb. in 100 U.S. gals.

On the more and (in brackets) less heavily infested of the two farms on which emulsion sprays were applied weekly, groups A, B and C had 10·3 (5·6), 9·8 (3·5) and 39·2 (21·7) flies per cow per day for six weeks, and A and B produced averages of 33·3 (17·3) and 36·2 (23·8) lb. more milk per cow per week than C. The fly numbers on both farms were significantly smaller on A than on C but not significantly smaller on B than on A. Higher milk yields from A and B were significant on all days of the week on the more heavily infested farm and on one and four, respectively of the seven days on the other one. Treatment increased milk production more in 1956 than in 1955, and monetary returns above the cost of the sprays were consequently greater. In view of the increased cost of the spray applied to the B groups, the increased returns from A and B were about the same. Similar results were obtained on the farm on which the sprays were applied twice a week, but the data were insufficient to show whether the additional applications were warranted.

On the farm on which the wettable powders were used, numbers of flies per cow in groups A, B and C on five days a week in the four weeks of dusting fell by 90–97, 89–95 and 79–86 per cent. and milk yield per day in the three groups increased by 11·6–12·7, 5–8·8 and 2·1–6·8 lb. In the four weeks of spraying, the flies per cow were reduced by 81–91, 86–95 and 84–91 per cent. in the three groups, but no effect of treatment on milk production was evident, possibly because populations of *S. irritans* had already been reduced and many of the cows were approaching the end of their lactation period.

Krueger (H. R.) & Casida (J. E.). **Toxicity of fifteen Organophosphorus Insecticides to several Insect Species and to Rats.**—*J. econ. Ent.* **50** no. 3 pp. 356–358, 5 refs. Menasha, Wis., 1957.

This paper, which is noticed elsewhere [*R.A.E.*, A **46** 231], includes tables giving the LD50's of 15 organophosphorus insecticides for insects of six species and rats, and of paraoxon for 22 additional species of insects. The LD50's are expressed in parts per million water for larvae of *Aëdes aegypti* (L.) and in µg. per g. body weight for the other insects, which were treated by topical application of acetone solutions, and for male white rats, which were treated by subcutaneous injection. The LD50's of paraoxon and (in brackets) malathion were 0·75 (120) for adults of *Blattella germanica* (L.), 0·5 (30) for adults of *Musca domestica* L., 0·01 (0·04) for the mosquito larvae, and 0·5 (1000) for the rats. The individual figures for these two compounds are quoted because paraoxon was the most toxic to the flies and cockroaches and had the highest average toxicity to the insects as a whole, and malathion showed the highest favourable ratio between insect and mammalian toxicity.

Miyake (S. S.), Kearns (C. W.) & Lipke (H.). **Distribution of DDT-Dehydrochlorinase in various Tissues of DDT-resistant House Flies.**—*J. econ. Ent.* **50** no. 3 pp. 359–360, 10 refs. Menasha, Wis., 1957.

The activity of DDT-dehydrochlorinase and the amount of water-soluble, biuret-positive protein were determined in various excised tissues of females of a DDT-resistant strain of *Musca domestica* L. The ratios of the amounts of DDT dehydrochlorinated per mg. soluble protein by the various tissues and (in brackets) the percentages of soluble protein in them were 183 (1·7) for fat-body, 65 (1·6) for brain, 42 (0·4) for cuticle, 26 (1·5) for haemolymph, 19 (2·4) for muscle, 2·1 (8·5) for ovary, and 1 (2) for intestinal tract. The data show that, with the possible exception of the digestive tract and ovary, DDT'ase is more or less ubiquitously distributed throughout the organism, and the low activity of the digestive tract may merely reflect destruction of the DDT'ase system by the proteolytic enzymes also present in gut extracts. The relatively high activity of the cuticle [*cf. R.A.E.*, B **39** 211], despite the low absolute quantity of DDT'ase in it, may be explained by the smallness of its content of soluble protein. With regard to the high activity of the fat-body, it is possible that lipoproteins help to dissolve the DDT, thereby increasing the rate of breakdown. Since lipoproteins are commonly associated with lipid-rich tissues, this may also hold true for nerve, as represented by the brain. Lipke and co-workers have shown that small amounts of lipoproteins, by virtue of their solubilising properties, so facilitate the action of DDT'ase that the enzymatic dehydrochlorination of DDT is rapid and complete. These data suggest that unchanged DDT in resistant flies [**42** 41, 133] is probably extracellular or retained in a system where it cannot act physiologically or be degraded. Various observations of differences in nervous reactions between resistant and susceptible flies have been held to indicate that factors other than detoxication are responsible for the survival of resistant flies [**42** 41; **43** 192; **44** 185]. However, in view of the demonstration of substantial levels of DDT'ase in the nervous system of resistant flies and the absence of this enzyme in susceptible flies [*cf.* **42** 6], the possibility that detoxication is the predominant factor responsible for the observed differences cannot be excluded.

Wilson (H. G.), Keller (J. C.) & Smith (C. N.). **Control of Fleas in Yards.**—*J. econ. Ent.* **50** no. 3 pp. 365–366, 3 refs. Menasha, Wis., 1957.

Numerous reports having been received from central Florida that DDT and chlordane were failing to control *Ctenocephalides felis* (Bch.) and *C. canis* (Curt.) where they had previously been used successfully, tests were carried out to compare them with γ BHC (lindane) and phosphorus insecticides on premises near Orlando on which one or other of them had been found ineffective by the owners. The phosphorus insecticides comprised diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], malathion, Dow ET-57 [purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate], chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate], Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate] and Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate]. All the insecticides were tested at a concentration of 1 per cent., and malathion also at 2 per cent., and diazinon at 0·5 per cent., in sprays applied to infested yards and to dog pens and houses and other areas that had become heavily infested. Most of the treated premises were about 5,000 sq. ft. in area, and applications were made at about 1 U.S. gal. per 1,000 sq. ft. and a pressure of 150 lb. per sq. inch. The use of an orchard-type nozzle enabled the spray to be projected for at least 25 ft. and so reach areas under houses that were difficult of access. Effectiveness was assessed by counting fleas landing or crawling in one minute on the lower parts of the legs of the observer at eight sites in each yard before and at various intervals after treatment. The results are given in a table. All the insecticides except chlordane and DDT were generally rapid in action and highly effective, and all except DDT gave 99–100 per cent. control for 7–9 weeks in some or all of the tests. The weaker malathion spray was quite as effective as the stronger one, and the latter gave very poor control in a test in which the rate of application was halved. Chlordane was slow in action in some yards, but eventually gave complete control in most cases. DDT failed to give satisfactory control.

KNIPLING (E. B. [*i.e.* E. F.]) & SULLIVAN (W. N.). **Insect Mortality at Low Temperatures.**—*J. econ. Ent.* **50** no. 3 pp. 368–369, 2 refs. Menasha, Wis., 1957.

Much attention has been given to means of killing insects in aircraft to prevent the spread of injurious species from one part of the world to another. Jet-powered aircraft, however, have to fly at altitudes at which outside temperatures range from −42 to −65°C. (−43·6 to −85°F.), and it is possible that insects hiding in the unheated parts of these aircraft would be killed by the cold to which they would be exposed. This possibility was investigated by exposing nymphs and adults of *Periplaneta americana* (L.) and grasshoppers, larvae and adults of *Epilachna varivestis* Muls., and adults of *Popillia japonica* Newm., *Tribolium confusum* Duv., *Aëdes aegypti* (L.), *Musca domestica* L. and *Dermacentor variabilis* (Say) to various low temperatures for one hour and then allowing them a recovery period of 24 hours at 10–35°C. (50–95°F.). Complete kill of all the insects except *Tribolium* was obtained by exposure to −15°C. [5°F.] and below, and of *A. aegypti*, but not the others, by exposure to −10°C. [14°F.]. *Tribolium* and *Dermacentor* were exceptional in that a few examples of both survived at −20°C. [−4°F.], though none did so at −15°C. or −30°C. [−22°F.]. A further test indicated that exposure to −20°C. for 12 minutes was adequate for 100 per cent. kill of *A. aegypti*, while exposure for 15 and 30 minutes resulted in 99 and 100 per cent. kill of *M. domestica*.

REID (W. M.) & LINKFIELD (R. L.). **New Distribution Record and economic Importance of** *Menacanthus cornutus* **(Schömmer) on Georgia Broilers.**—*J. econ. Ent.* **50** no. 3 pp. 375–376, 1 ref. Menasha, Wis., 1957.

Menacanthus cornutus (Schömmer), which was first recorded on fowls in the United States in 1956 [*R.A.E.*, B **45** 209] but may have been previously confused with *M. stramineus* (Nitzsch), was responsible for a heavy infestation found in August of that year on a flock of broilers at a processing plant in Georgia. Hundreds of lice were present on each of the 3,500 birds in the flock. These had shown poor growth and had reddish marks at the shoulder areas [*cf.* **32** 231]. Two weeks earlier, a similar but lighter infestation had been noticed in another group of 3,500 birds from an adjoining house on the same farm. It was found that some adult hens had access to an area under the feed room of the houses from which the two flocks came, and though it was not possible to examine them, it is assumed that they were responsible for the infestation. Ten birds from each of 100 flocks were examined at market age (8–10 weeks) at the processing plant between October 1955 and January 1957, but none was found to be infested with ectoparasites of any kind apart from the ten from the heavily infested flock, and workers at the plant reported no infestation among any of the 20,413,583 broilers dealt with during this period, except those in the two flocks mentioned.

VINOGRADSKAYA (O. N.). **The Effect of the Temperature of the Water in which the Larvae develop on the Size of the Spiracles of winged Mosquitos (Diptera, Culicidae).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **112** no. 2 pp. 366–368, 4 refs. Moscow, 1957.

Previous investigations by the author have shown that the spiracles of mosquitos are smaller in xerophilous than in hygrophilous species [*R.A.E.*, B **41** 84, etc.] and smaller in species of *Aëdes* or individuals of *Anopheles* *maculipennis messeae* Flni. that emerge in summer than in those that emerge in spring or autumn [**43** 106]. She also found that the thoracic spiracle index [**31** 188] was about 17·2 in *Calliphora vicina* R.-D. (*erythrocephala* (Mg.)), a blowfly that occurs in the cooler northern parts of the Soviet Union, and only 13·6 in *C. uralensis* Villen., a xerophilous species found in the south.

It thus appeared that smallness of spiracles is an adaptation to a dry climate, but that it may be induced in mosquitos by development of the larvae in warm water, since temperature and humidity are closely related in nature. This was confirmed by experiments in 1953 in which third- or fourth-instar larvae collected near Moscow or third-instar larvae bred in the laboratory were reared to adults in water at a temperature of 25°C. [77°F.] or 12–15°C. [53·6–59°F.]. The thoracic spiracle indices of males that had been reared in the warm and (in brackets) cool water averaged 8·1 (12·3) for *A. m. messeae*, 8·4 (11·8) for *A. m. atroparvus* van Thiel, 9 (10·7) for *Culex pipiens* L., 8·4 (12·4) for *Aëdes dorsalis* (Mg.) and 10·1 (13·8) for *Culiseta* (*Theobaldia*) *alaskaensis* (Ludl.), and the corresponding averages for females of the first four were 7·8 (12·1), 8 (12·3), 10 (11·5) and 7·7 (11·5). The ranges in the indices overlapped only in *Culex pipiens*, of which no third-instar larvae were available for rearing.

Reid (J. A.). **Field Trials of Larvicides for Use against** *Culex pipiens fatigans*, **with a Note on the Life-cycle of this Mosquito.**—*Ann. trop. Med. Parasit.* **50** no. 2 pp. 129–136, 18 refs. Liverpool, 1956.

An account is given of experiments in Malaya in which the effectiveness of various larvicides against *Culex pipiens fatigans* Wied. in stagnant drains containing very dirty water was assessed by the differences in numbers of larvae before and 24 hours after they were applied. In all trials except one, in which a dropping bottle was used, the larvicides were applied as sprays, and emulsion concentrates and wettable powders were so diluted that application could be made at 20 gals. per acre of water surface. The effectiveness of antimalarial oil was 95 per cent. when it was applied at 39 gals. per acre and 74 per cent. at the more usual rate of 24 gals. DDT gave poor results at 4–34 oz. per acre in an emulsified solution, and had no effect at all at 34 oz. in a wettable-powder suspension. Both adults and larvae of *C. p. fatigans* have low susceptibility to DDT, at least in Malaya [*R.A.E.*, B **43** 169–170; *cf.* also **45** 131], and it is probable that even the heavy doses used made a concentration inadequate to kill all larvae. There may also have been sorption of DDT by mud and organic matter in the water [*cf.* **38** 13; **42** 28, etc.]. The effectiveness of BHC at 4–11 oz. γ isomer per acre as a wettable-powder suspension was 97–99 per cent. and that of dieldrin in emulsion was 97 per cent. at 3 oz. per acre and 91 per cent. at 5 oz. The apparently poorer control given by the higher dosage of dieldrin was due to the presence of larvae that hatched during the 24 hours after it was applied; it was 99 per cent. effective if these were ignored. Sorption may prevent dieldrin and BHC from having any lasting effect, though their considerable toxicity enables them to give initial control. Numbers of pupae fell after all treatments, but it is doubtful whether there was any direct effect except with the oil, the reductions that followed application of the synthetic larvicides probably reflecting an excess of emergence over pupation owing to the killing of larvae. Since the presence of *C. p. fatigans* usually indicates unsanitary conditions, its control should for choice be based on sanitation, but until good sanitation is achieved, more effective larvicides are needed.

In laboratory colonies of *C. p. fatigans* reared at 78–85°F., the life-cycle from egg to adult generally occupied 7½–8½ days (sometimes 8½–9½ days), the egg, larval and pupal stages lasting 1, 5–6 and 1½–2½ days, respectively.

Few females took a blood-meal until five days or more after emergence. Egg-rafts were mostly laid 3–7 days after the blood-meal.

Davidson (G.) & Ganapathipillai (A.). **Observations on the Bionomics of the Adults of some Malayan Anopheline Mosquitoes.**—*Ann. trop. Med. Parasit.* **50** no. 2 pp. 137–146, 11 refs. Liverpool, 1956.

During investigations on the epidemiology of malaria transmitted by *Anopheles maculatus* Theo. in an inland valley of Malaya, near Kuala Lumpur, data were collected on the habits of the adults of several species of *Anopheles*. Most of the observations were made near an aboriginal resettlement village in which the only large animal was a water-buffalo tethered some 50 yards away. There were also a few dogs and fowls. Catching methods included leg-catches, in which four youths stationed in pairs in the open on the periphery of the village caught mosquitos alighting on their bare legs between 7 and 11 p.m., use of a mosquito-net trap with human bait, an experimental hut fitted with window exit-traps, exit-traps on existing houses, a calf-baited Magoon trap [*R.A.E.*, B **23** 302] and a dog-baited mosquito-net trap, and collection of mosquitos from grass round the tethered buffalo and of mosquitos resting out of doors by day.

The following is substantially the authors' summary of the findings, which confirmed Wharton's observations [**41** 162; **43** 8] in another part of Malaya. The principal Anophelines taken were *A. aconitus* Dön., *A. barbirostris* Wulp (light-winged form [*cf.* **34** 32]), *A. hyrcanus crawfordi* Reid, *A. h. indiensis* Theo., *A. karwari* (James), *A. kochi* Dön., *A. maculatus* and *A. philippinensis* Ludl. All preferred to feed out of doors, and *A. maculatus* was the only one that readily entered houses to feed. The results of the different methods of catching, and of precipitin tests on the blood from a few females of *A. maculatus* found resting out of doors in the day-time, showed that at the village *A. maculatus* was feeding predominantly on man and only to a small extent on dogs. *A. philippinensis*, which was much the most abundant species, *A. h. indiensis*, *A. kochi* and *A. barbirostris* were appreciably attracted to the water-buffalo or the calf-baited or dog-baited trap or more than one of them. *A. aconitus*, *A. h. crawfordi* and *A. karwari*, though commonly found near the water-buffalo or in the animal-baited traps, tended to form a higher proportion of the catches from man.

Fairbairn (H.). **The Infectivity to Man of Syringe-passaged Strains of *Trypanosoma rhodesiense* and *T. gambiense*.**—*Ann. trop. Med. Parasit.* **50** no. 2 pp. 167–171, 8 refs. Liverpool, 1956.

The following is substantially the author's summary. The Tinde strain of *Trypanosoma rhodesiense* passaged cyclically through sheep by *Glossina morsitans* Westw. was still infective to man 18½ years after isolation [*R.A.E.*, B **45** 83]. A branch line of this strain was maintained by syringe passage through 16 or 18 rats and 2,306 mice [*cf.* **38** 47], and 18½ years after the beginning of the syringe passages, 25 million trypanosomes were inoculated into the author's arm. A modified local reaction was produced, but no trypanosomes were found on puncture. No general infection occurred in the 28 days during which the experiment was allowed to run. This suggests that there had been an attempt at infection, which had been overcome. The trypanosomes inoculated were measured. No short forms were present, and the mean lengths of the intermediate and long forms were 19·61μ and 22·18μ respectively. These mean lengths are markedly shorter than those in the strain transmitted by *Glossina* [*cf.* **38** 47].

The occurrence of accidental infection in man with a strain (M) of *T. gambiense* that had been syringe-passaged through 108 animals over a period of four years is recorded. The intermediate and long forms of this strain measured 25·94μ and 29·37μ, respectively. These measurements are similar to those of a strain transmitted by *Glossina*. No short forms were present, which suggests that short forms are not essential for infection of man. Infection of man depends on the presence of long or intermediate forms, or both, the lengths of which are equal to or greater than the mean lengths of similar forms in a strain transmitted by *Glossina*.

HEISCH (R. B.), GUGGISBERG (C. A. W.) & TEESDALE (C.). **Studies in Leishmaniasis in East Africa. II. The Sandflies of the Kitui Kala-azar Area in Kenya, with Descriptions of six new Species.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 3 pp. 209–226, 8 figs., 9 refs. London, 1956.

Detailed information was given in the first paper in this series [*R.A.E.*, B **43** 140] on some of the sandflies (*Phlebotomus*) of the Kitui District of Kenya, in an area of which an outbreak of visceral leishmaniasis (kala-azar) had occurred. More material was subsequently collected, and the number of specimens examined increased to over 20,000. An account is given of what is known of the distribution, monthly incidence and habits of the 16 species and one variety that they comprised, together with descriptions of the six that were new. These are *P.* (*P.*) *vansomerenae*, *P.* (*Sintonius*) *graingeri*, *P.* (*Sergentomyia*) *garnhami* (referred to in the previous abstract [**43** 141] as S2), *P.* (*S.*) *rosannae* (S 1) and *P.* (*S.*) *harveyi*, all described from both sexes, and *P.* (*S.*) *multidens* described from females. The material referred to in the previous paper as an undescribed species related to the group of *P. major* Annan. was found to comprise a mixture of *P. vansomerenae* and *P. martini* Parr. The other additions to the previous list are *P. orientalis* Parr., of which a single male was found in a batch from an empty burrow, *P. adleri* Thdr., which was taken in small numbers, usually in termitaria and empty burrows, and *P. bedfordi* var. *congolensis* Beq. & Walr., which was comparatively rare.

The sandflies observed to attack man were *P. schwetzi* Adl., Thdr. & Parr., *P. kirki* Parr., *P. martini* and all the new species except *P. graingeri*, but *P. garnhami* was the only one caught biting in large numbers. It usually bit near termite hills, but sometimes in millet fields and occasionally in houses, and had peaks of activity in the morning and evening. It was at first considered the most likely vector of kala-azar north of Kitui, and flagellates undergoing " anterior development " were found in 5 per cent. of examples fed on a cutaneous lesion. However, this infection rate is rather low for a potential vector, and *P. martini* and *P. vansomerenae* are now thought to be the species most likely to be concerned. Many of the sandflies round Kitui feed on lizards. Flagellates (probably derived from lizards) were observed in *P. clydei* Sinton, *P. bedfordi* Newst., *P. schwetzi*, *P. squamipleuris* Newst. and *P. garnhami*.

Additions to keys to the Ethiopian sandflies [**41** 17], incorporating the new species, are given in an appendix.

REID (J. A.). **A small Trial of insecticidal Resins for Control of Cockroaches.** —*Trans. R. Soc. trop. Med. Hyg.* **50** no. 3 pp. 227–231, 5 refs. London, 1956.

Work by Block [*R.A.E.*, B **38** 67] and Bracey [*cf.* A **43** 255] has shown that surface coatings of urea-formaldehyde resin containing suitable insecticides are toxic to insects for long periods, and Bracey has found that a satisfactory mixture for applying such a coating is 50 parts urea-formaldehyde resin, 50 parts castor-oil alkyd resin, 27·5 parts butanol, 22·5 parts xylene and 12 parts insecticide. This forms a clear free-flowing lacquer to 20 parts of which one part of an acid accelerator (10 per cent. sulphuric acid in butanol) is added just before use. The accelerator promotes drying and hardening of the lacquer, and the result, when dry, is a colourless transparent coating containing 20 per cent. insecticide.

An account is given of a small experiment made in 1953 in Malaya on the use of insecticidal lacquer to treat rabbit cages for the control of cockroaches (predominantly *Nauphoeta cinerea* (Ol.)) and Tenebrionid beetles. Each cage consisted of a light main chamber and a smaller dark nesting chamber. Six cages were cleaned, and four were painted thoroughly on the inside on 12th June with a lacquer containing 2 per cent. γ BHC and 16 per cent. DDT calculated on dry weight and two with one containing 2 per cent. aldrin and 10 per cent. dieldrin. Four days after treatment, rabbits were put in the cages, which were then replaced at random among about 15 untreated ones. Treated and untreated cages received the same amount of use and cleaning, except that the insides of the treated ones were washed after seven months to remove dirt that might have been masking the insecticides. The nesting chambers of the treated and six untreated cages were searched for insects at first weekly and then monthly for 11 months. During this time, 155 insects, of which 68 per cent. were dead, were collected from the treated cages, and 423, of which only 2 per cent. were dead, from the untreated cages. No living insects were found in seven out of 15 searches of the treated cages, including those made in the two months following the washing, but dead insects were always found. Living insects were always present in the untreated cages. There was no obvious decrease in the effectiveness of the treatments in the 11 months, and it is not known how much longer it would have lasted. The trial was too small for any difference to be detected between the two formulations. On the assumption that the LD50 of DDT and BHC for rabbits is 200 mg. per kg. and that of dieldrin and aldrin 50 mg. and that the lacquer was applied at about 1 oz. solids per sq. ft., it was calculated that a rabbit weighing 1 kg. might obtain a lethal dose by nibbling and swallowing about 1 per cent. of the surface. In fact, no ill effects were reported. Another possible disadvantage of the method is that animals kept in treated cages might have enough insecticide on their fur to be toxic to insects fed on them for experimental purposes.

Boorman (J. P. T.) & Porterfield (J. S.). **A simple Technique for Infection of Mosquitoes with Viruses. Transmission of Zika Virus.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 3 pp. 238–242, 1 graph, 8 refs. London, 1956.

Zika virus was first isolated from a captive monkey and *Aëdes* [*africanus* (Theo.)] in the Zika Forest, Uganda, and antibodies against it were found in man in the Protectorate [*R.A.E.*, B **42** 164]. It has also been isolated from man in Nigeria, and serological examinations have suggested that it is widespread there. A laboratory study of its transmission by mosquitos was therefore undertaken. Females of *A. aegypti* (L.) were used, and since no animal is known that circulates Zika virus at high titre, they were infected by feeding them on a mixture of heparinised mouse blood and infected mouse-brain suspension, in which the concentration of virus was $10^{6\cdot7}$ mouse LD50's per 0·03 ml. The tops of three tubes containing the mixture were covered with pieces of skin of adult mice, held in position by rubber bands, and the hair on the skin was clipped short with scissors. The tubes were immersed in water at 40°C. [104°F.] until their contents reached this temperature and then inverted on the netting top of a small cage of mosquitos. The mosquitos rose rapidly to the bait, and nearly half of them had engorged in 30 minutes. Those that had done so were then kept at a temperature and relative humidity of about 24°C. [75·2°F.] and 90 per cent. in a cage containing a dish of cotton-wool soaked in glucose solution. Immediately after feeding and on every succeeding fifth day for 60 days, two mosquitos were removed and their virus content (mouse LD50's per mosquito) was determined. At the first examination, the content was $10^{5\cdot4}$. No virus was detectable on the fifth and tenth days, but the contents were $10^{3\cdot4}$ and $10^{5\cdot6}$ on the 15th and 20th days and about 10^{5} on all days, from the 25th to the 60th. This strongly suggests that the virus had multiplied, although the original titre was not exceeded. A proportion of back-feeding experiments, in which presumably infective mosquitos were induced to feed on uninfected heparinised mouse-blood through the membrane, showed positive results. A rhesus monkey [*Macaca mulatta*] on which three females engorged 72 days after their infective meal remained healthy but developed antibody to Zika virus. Five out of ten suckling mice on each of which one mosquito was given the opportunity to engorge, subsequently died of the infection. The significance of the findings in the epidemiology of Zika virus is uncertain. The dose of virus used to infect the mosquitos was high. Levels of circulating virus in experimental animals are much lower, and the levels that occur naturally in man are not known. Until it is shown that *A. aegypti* can be infected with smaller doses of virus than those used, its effectiveness as a vector in nature remains uncertain.

Tsai (S. T.), Ko (H. L.), Jung (C.) & Li (C. Y.). **Studies on the Insect Vectors of B Type Encephalitis in Canton.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 4 pp. 369–378, 27 refs. [Peking] 1957. (With a Summary in English.)

The mosquitos found to be common in the city or suburbs of Canton in 1953–55 were *Culex pipiens fatigans* Wied., *Aëdes albopictus* (Skuse), *Anopheles hyrcanus sinensis* Wied. and *C. tritaeniorhynchus* Giles. *C. p. fatigans* was the most abundant everywhere, followed by *Aëdes albopictus* in the city and by *Anopheles h. sinensis* in the suburbs. *C. p. fatigans* retained its numerical superiority throughout the year, *A. h. sinensis* reached peaks of abundance in April and October, *C. tritaeniorhynchus* in May, June and September, and *Aëdes albopictus* in summer and autumn. Because of the abundance of *C. p. fatigans* and coincidence of the seasonal incidence of *A. albopictus* with that of Japanese B encephalitis, the part these mosquitos might play as vectors of the disease was investigated. Both acquired the infection when allowed to feed on infected mice or given an artificial infective feed, and both subsequently transmitted it, after periods of up to 14 days for *A. albopictus* and 27 days for *C. p. fatigans*, though positive results were obtained with 18 of 21 batches of *albopictus* and only eight of 42 of *fatigans*. Over 7,700 adults of *C. p. fatigans* were collected in Canton during 1955, and the virus was isolated from three of the 304 batches that they comprised. This is thought by the authors to be the first record of the finding of natural infection in *C. p. fatigans* in China [but *cf. R.A.E.*, B **46** 35]. Of females of this mosquito that contained identifiable blood, the percentages that had fed on man, pigs and cattle were, respectively, 86·8, 4·7 and 0·38 in dwellings, 2·3, 88·6 and 0 in pig pens, and 12·6, 29·5 and 49·4 in cow sheds.

Yu (En-shu) & Lin (Sh-jing [She-gin]). **Study on the Condition of natural Infection with** *R. tsutsugamushi* **among Mites and domestic Animals in Fukien.** [*In Chinese.*]—*Acta microbiol. sinica* **5** no. 4 pp. 425–432, 1 graph, 16 refs. [Peking] 1957. (With a Summary in English.)

In the course of a search for vectors and reservoirs of tsutsugamushi disease in various districts of Fukien between 1953 and 1957, strains of

Rickettsia orientalis (*tsutsugamushi*) were isolated from *Trombicula deliensis* Walch, *E*[*uschöngastia*] *indica* (Hirst), *Acomatacarus* sp. and *Walchia* sp. and from rabbits [*cf.* *R.A.E.*, B **46** 58], pigs, rats (*Rattus losea*, *R. norvegicus* and *R. rattus*), mice (*Mus musculus* and *M. bactrianus kakhyenensis*) and a shrew (*Suncus murinus*).

Bergmann (E. D.), Moses (P.) & Neeman (M.). **Studies on organic Fluorine Compounds. VIII. *N*-substituted Fluoroacetamides as Insecticides and Rodenticides.**—*J. Sci. Fd Agric.* **8** no. 7 pp. 400–404, 18 refs. London, 1957.

Results are given of experiments in which fluoroacetamide and 12 N-mono- and five N,N-di-substituted fluoroacetamides were tested for toxicity to third-instar larvae of *Musca domestica vicina* Macq. of a strain slightly resistant to DDT, females (2–3 days old) of a strain of *M. d. vicina* highly resistant to DDT, and male white rats. Larvae were kept for 48 hours in a bran medium containing 100 parts per million of the amides and then examined for mortality, adult flies were kept for two hours in contact with a deposit one day old of 1 gm. per sq. metre on glass, and rats were given the poisons by intraperitoneal injection and sometimes by stomach tube. All the mono-substituted amides were toxic to the larvae at the concentration used, causing 51–83 per cent. mortality. Fluoroacetamide itself caused 84 per cent. Relatively large N-aryl substituents somewhat decreased the larvicidal activity of the amides. Di-substituted amides were inactive or only slightly active. Only the amides mono-substituted by relatively small aryl radicals (phenyl, p-tolyl, p-fluorophenyl and p-chlorophenyl) were toxic to the highly resistant adult flies. These four gave mortalities of 60, 57, 95 and 52 per cent., respectively. All the compounds were toxic to the rats. The approximate LD50 values for N-monoarylamides were lowest (4–8 mg. per kg.) for those with small aryl radicals and somewhat higher for those with larger aryl substituents (α- and β-naphthyl, p-diphenylyl and p-bromophenyl). The molar LD50 values of the N-arylamides fall within a narrow range. The possible mode of action of the toxicants is discussed.

Gilbert (I. H.), Gouck (H. K.) & Smith (C. N.). **New Insect Repellent.** —*Soap & chem. Spec.* **33** no. 5 pp. 115–117, 129, 131, 133; no. 6 pp. 95, 97, 99, 109, 4 figs., 8 refs. New York, N. Y., 1957.

Diethyltoluamide was the most effective of 12 repellents tested against mosquitos breeding in snow water and irrigation water in Oregon and showed some promise against *Chrysops discalis* Will. there [*R.A.E.*, B **46** 44]. Both it and o-ethoxy-N,N-diethylbenzamide were highly effective for treatment of clothing against ticks [**44** 169], and N,N-diethyl-m-toluamide has shown outstanding qualities as a mosquito repellent [**44** 23; **45** 6, 47]. In this paper, an account is given of studies carried out over a period of two years of technical diethyltoluamide (containing about 70, 27 and 3 per cent., respectively, of the meta, para and ortho isomers of N,N-diethyltoluamide), N,N-diethyl-o-toluamide, o-ethoxy-N,N-diethylbenzamide and a number of mixtures containing one or two of them in comparison with ethyl hexanediol and standard mixtures as repellents against various arthropods.

The following is substantially the authors' summary of the results. Applied to skin, diethyltoluamide was the most effective repellent in protection-time tests against *Aëdes aegypti* (L.) and *A. taeniorhynchus* (Wied.), and mixtures containing it were about as effective as would be expected from the amount of each ingredient. Diethyltoluamide was about twice as effective against *A. taeniorhynchus* as the standard M-2020 (a 4 : 3 : 3

mixture of dimethyl phthalate, dimethyl carbate and ethyl hexanediol). It retained its superiority against both species under sweating conditions. Its margin of superiority was even greater with respect to resistance to removal from the skin by wiping and rinsing. Decreasing the amount of meta isomer by adding the pure ortho isomer to the technical product reduced its effectiveness against both species, especially its resistance to wiping. Diethyltoluamide and mixtures containing it were more effective than the standard 6:2:2 mixture of dimethyl phthalate, ethyl hexanediol and Indalone against *Anopheles quadrimaculatus* Say at a concentration of 10 per cent. in ethanol but not at 5 per cent. Of the repellents tested against *Mansonia perturbans* (Wlk.), o-ethoxy-N,N-diethylbenzamide was best at low concentrations, but at full strength all afforded complete protection throughout the short period in the evening when this species was active. Diethyltoluamide and one mixture containing it were the most effective repellents tested against *Stomoxys calcitrans* (L.) and *Chrysops atlantica* Pechuman, and diethyltoluamide was the most effective against *Culicoides canithorax* Hoffman.

As clothing treatments, diethyltoluamide and mixtures containing it were more effective than the standard M-1960 [**42** 185] against *Aëdes aegypti*, about equal against *A. taeniorhynchus*, more effective against *Xenopsylla cheopis* (Roths.) and less effective against *Amblyomma americanum* (L.). Against *Trombicula splendens* Ewing, diethyltoluamide and some mixtures containing it were highly effective as fresh treatments and retained their effectiveness longer than M-1960, but were less resistant to rinsing.

BRIDGES (P. M.). **Absorption and Metabolism of [^{14}C] Allethrin by the Adult Housefly,** *Musca domestica* **L.**—*Biochem. J.* **66** no. 2 pp. 316–320, 1 graph, 18 refs. Cambridge, 1957.

The following is virtually the author's summary. Allethrin labelled with ^{14}C was incubated with enzyme extracts or homogenates or it was injected into adult house-flies (*Musca domestica* L.). After a " metabolism " period, any unchanged allethrin and its metabolites were extracted, resolved by paper chromatography and determined radiometrically. A considerable fraction of the allethrin injected into female house-flies was metabolised in 24 hours [*cf. R.A.E.*, B **44** 186]. The proportion of the metabolism occurring in the first five hours of this period was 80 per cent. The net weights of allethrin metabolised by a male lipase extract and a female abdomen homogenate were small and of doubtful significance. Metabolism of allethrin by female thoracic homogenates could not be detected. A sublethal exposure to methyl bromide inhibited the metabolism of allethrin. There was some evidence that benzaldehyde, a lipase inhibitor, reduced the metabolism of allethrin *in vivo* at the higher concentrations used.

Absorption of topically applied allethrin was rapid during the first 5–10 hours after application. The fraction of the dose absorbed in 24 hours approached unity at lower doses but fell off significantly at higher doses.

PAPERS NOTICED BY TITLE ONLY.

IYENGAR (M. O. T.). **Annotated Bibliography on Filariasis and Elephantiasis. Part 3. Symptomatology, Aetiology, Pathology and Diagnosis of Filariasis due to** *Wuchereria bancrofti* **and** *W. malayi*.—*Tech. Pap. S. Pacif. Comm.* no. 109, xvi + 276 pp., multigraph. Nouméa, 1957. [*Cf. R.A.E.*, B **44** 181.]

BERLIN (L. B.). **Histological Changes occurring in the Skin of Rabbits and Guineapigs as a Result of Feeding on them of Ticks** *Hyalomma asiaticum* **P.Sch. et E. Schl. (Fam. Ixodidae).** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **112** no. 2 pp. 340–343, 1 pl., 22 refs. Moscow, 1957.

COMMONWEALTH INSTITUTE OF BIOLOGICAL CONTROL

RETIREMENT OF DR. W. R. THOMPSON, F.R.S., F.R.S. CANADA.

With the retirement at the end of June of Dr. W. R. Thompson, Director of the Commonwealth Institute of Biological Control, entomology in general and biological control in particular suffered a severe loss, which will be especially felt by the staff of that Institute, and by the many entomologists with whom Dr. Thompson has dealt officially.

Prior to joining the staff of the Imperial Institute (then Bureau) of Entomology in 1928, Dr. Thompson had had wide experience in biological control work with the United States Bureau of Entomology. He was an Assistant Director of the Institute, and was Superintendent of its parasite laboratory at Farnham Royal from 1928 to 1939. During these years, extensive work on biological control was done under Dr. Thompson's direction, particularly in Europe, for Canada, Australia and New Zealand.

The outbreak of war in 1939 made work in Europe impossible and Dr. Thompson went to Canada in 1940 to rebuild the organisation, of which he became the Director, and enable it to increase its work. It was at first termed the Imperial Parasite Service, but was raised to the status of an independent Bureau in 1946 and became the Commonwealth Institute of Biological Control in 1951. Its headquarters are in Ottawa, and it has stations in California, Switzerland and Trinidad, together with others, more recently established with funds from the Colombo Plan, in India and Pakistan. The scope of the Institute has expanded considerably during this time, particularly in the tropical field, due to the vigorous efforts of Dr. Thompson.

In addition to this work on practical problems of biological control, Dr. Thompson initiated the production of the *Catalogue of the Parasites and Predators of Insect Pests*, a list, with references, of records from the literature. Some fifteen volumes have already been published.

Dr. Thompson was a pioneer in the field of the mathematical theory of population growth, particularly with regard to parasite populations, and its bearing on biological control. He was elected a Fellow of the Royal Society in 1932 and of the Royal Society of Canada in 1949. His position in the field of entomology in general is well illustrated by the fact that he was invited to be President of the 10th International Congress of Entomology, held at Montreal in 1956.

Since 1942, Dr. Thompson has been editor of the *Canadian Entomologist*, and in addition to his many duties and interests, both entomological and philosophical, he has done extensive research into the taxonomy and systematics of the Tachinids. It is comforting to know that his official retirement will not mean the end of his entomological activities.

Dr. Thompson is succeeded as Director by Dr. F. J. Simmonds, who joined the staff of the Farnham House Laboratory at Farnham Royal in 1939 and has latterly been in charge of the Institute's station in Trinidad.

T. SWAMINATHAN, I.C.S.

Chairman of the Executive Council of the
Commonwealth Agricultural Bureaux.

July, 1958.

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Dingle (J.). **Settling Rates of D.D.T. and B.H.C. Suspensions in Cattle Dipping Baths.**—*Aust. vet. J.* **32** no. 6 pp. 132–137, 8 figs., 1 ref. Sydney, 1956.

As BHC and DDT are mainly in the particulate form and are almost insoluble in water, they settle out in dipping baths. In current practice in New South Wales, where they are used for the control of *Boophilus annulatus microplus* (Can.), the dips are prepared to contain 0·56 per cent. total BHC or p,p′DDT. A bath of average size is filled to a height of 6¼ ft. and then contains about 2,350 gals. liquid, which requires much agitation each time it is used. The standard method is to lift the matter from the bottom of the bath with a long-handled shovel, having a rope attached to the front, and then send ten head of cattle through as stirrers. The strength of the dip is sampled at least every 28 days, with a device by means of which two jars are immersed mouth downwards to a depth of 3 ft., inverted and brought to the surface. They are then covered with screw tops, and the samples are sent to the laboratory in them. The method of analysis and the method of determining and adjusting the hardness of the water are briefly described.

To determine the time that could be allowed to elapse between dippings before the concentration falls below the effective level, dips were maintained in the usual way and samples were taken from them immediately after agitation with shovel and animal stirrers and 5, 10, 15, 20, 30, 40, 50, 60 and 70 minutes later. The changes in concentrations of DDT and BHC are shown in graphs. Except in a few cases, the concentration of DDT fell below the level that is considered satisfactory (0·3 per cent. p,p′) within 30 minutes. In practice, not more than ten minutes is allowed, to give a margin of safety. The concentration of BHC sometimes remained above 0·3 per cent. for more than an hour. Dips containing only 0·3 per cent. total BHC or p,p′ DDT should not be allowed to stand for more than 2–3 minutes. Rates of settling were sometimes very irregular, but the dips appeared to stabilise at a level between 0·1 and 0·2 per cent.

The difference in the settling rates of DDT and BHC is discussed. Examination of a dip prepared with Gamatik (a mixture of commercial BHC and a wetting agent), in which suspensions were usually good, showed that particles of mud were mixed with particles of BHC, but the DDT preparation, Rucide [*R.A.E.*, B **36** 101], is melted and poured into the bath to form a colloidal suspension from which DDT crystallises, so that the dip contains a mixture of colloidal crystals and microcrystalline DDT in the proportion of about 2:3. Several factors, notably age, cause variations in the ratio. The percentages of p,p′ isomer in the DDT are 73 in Rucide, and about 94 and 45 in the crystallised and colloidal portions, respectively. The settling rate is affected by the size and habit of the crystals and the charge on them. Groups of crystals form, which may be tightly packed and in a dense flake formation or loosely packed in the form of a light flocculate. With use and consequent muddying of the bath, the flocculate form becomes dispersed, whilst the crystals from the dense flake formation settle and become unavailable. Flocculates are formed from long thin needle-like crystals, reported to be the most toxic form of DDT [A **36** 376], whereas the denser flakes are formed from plate-like crystals. The form of the crystal is modified by the salt content of the bath and the degree of fineness of the mud in it. Clean water with a low salt content produces plate-like crystals. Good flocculates can apparently be produced by a total salt content (including calcium salts) of 0·5–1·5 per cent. Calcium salts do not lend themselves as readily as do sodium salts to the most desirable crystal habit and flocculate. When conditions are at their best, the mud of the dip prevents the particles from flocculating, and in this case the crystals each have a particle of clay attached to the middle of the needle.

There is a danger, if excessive water softener is used with new Rucide dips, particularly those having a pH of 6·5–7·5, that the flocculate may float to the surface and mix with the froth. Outside this range, the flocculate generally sinks. When the surface froth contains excessive DDT, it dries to form a scum, with resulting serious stripping out on the coats of the cattle. At the other extreme, it is possible, by means of detergents, to disperse the flocculates completely and cause them to settle in a thin layer on the bottom of the bath. When a bath is stripping seriously, some control can be obtained by lowering the pH, or by adding a detergent, hard water or some pug clay.

In some cases in which the DDT had settled and become difficult to resuspend after a dip had been in use for several years, the position was much improved by the addition of " Calgon " (a commercial form of sodium metaphosphate) to the bath to the point where a froth was produced.

Burgdorfer (W.) & Pickens (E. G.). **A Technique employing embryonated Chicken Eggs for the Infection of Argasid Ticks with** *Coxiella burnetii*, *Bacterium tularense*, *Leptospira icterohaemorrhagiae*, **and Western Equine Encephalitis Virus.**—*J. infect. Dis.* **94** pp. 84–89, 1 fig., 12 refs. Chicago, Ill., 1954.

Pierce (A. E.) & Pierce (M. H.). **A Note on the Cultivation of** *Boophilus microplus* **(Canestrini, 1887) (Ixodidae: Acarina) on the embryonated Hen Egg.**—*Aust. vet. J.* **32** no. 6 pp. 144–146, 4 figs., 9 refs. Sydney, 1956.

Details are given in the first paper of a method by which larvae, nymphs and adults of ticks of the genus *Ornithodoros* were fed on the air-sac membrane of embryonated hens' eggs. The method can be used to infect ticks with disease agents that may be cultivated in the embryos, to test their ability to ingest, preserve or transmit them, to study the life-cycle and behaviour of such agents in the ticks and to detect infected ticks. Four species of *Ornithodoros* were successfully fed, but several attempts to feed *Argas reflexus* (F.) by the same method failed. *O. moubata* (Murr.) and *O. turicata* (Dugès) were infected with *Bacterium tularense*, *Leptospira icterohaemorrhagiae* and the virus of western equine encephalitis and *O. moubata* with *Coxiella burneti* by feeding them on infected embryos. *B. tularense* persisted and developed in the ticks for more than 200 days and was ejected with the coxal fluid during engorgement. *L. icterohaemorrhagiae* was found to penetrate the gut wall, enter the body cavity and invade principally the central ganglion and the coxal organs and was ejected with coxal fluid. The encephalitis virus survived in the ticks for at least 25 days. Normal eggs were used to detect infections of *Borrelia turicatae* in *O. turicata* and *B. parkeri* in *O. parkeri* Cooley.

The cultivation of *Boophilus annulatus microplus* (Can.) from the larval to the nymphal stage on the air-sac membrane of embryonated hens' eggs is described in the second paper. The larvae were put on the membrane in clusters of 150–200 and those that were not attached after five days were removed. Maximum attachment occurred within 48 hours. Of 104 larvae that were attached on 24 eggs after five days, 86 were still attached after 8–9 days and 37 moulted during the next five days. Most of the resulting nymphs reattached for periods of up to eight days, but none moulted to the adult stage. However, young adults from engorged nymphs removed from cattle and allowed to moult *in vitro* attached to the membrane for short periods. Blood smears made from many of the chick embryos during the fortnight after the attachment of the larvae yielded no evidence that the latter had transmitted *Piroplasma* (*Babesia*), *Theileria* or *Anaplasma* to them, but smears of internal organs failed to show that these protozoa were present in the ticks. Organisms of a rickettsial nature were seen in preparations of larvae of the tick and of eggs dissected from or deposited by females. They appeared to be similar to microorganisms described by Cowdrey from various species of Argasid and Ixodid ticks [*R.A.E.*, B **12** 34; **14** 213].

Walker (J. B.). *Rhipicephalus pravus* **Dönitz, 1910.**—*Parasitology* **46** no. 3–4 pp. 243–260, 11 figs., 37 refs. London, 1956.

Rhipicephalus pravus was described very briefly by Dönitz in 1910 from adults collected in Tanganyika, and the adults were redescribed in detail by Zumpt [*R.A.E.*, B **31** 6] from material collected in Tanganyika, Kenya and Ethiopia. Descriptions are here given of the larva, nymph and adults of both sexes on the basis of specimens that were the offspring of a single female collected in Kenya. They showed a considerable range of variation, and the type series of *R. neavei* Warb. and *R. n. punctatus* Warb. were found to represent the two extremes of this range, so that both are synonyms of *R. pravus*. The features distinguishing *R. pravus* from *R. appendiculatus* Neum., *R. oculatus* Neum. and *R. bursa* C. & F., with which it has been confused in the past, are discussed; present-day findings suggest that *R. bursa* is not found in Africa south of the Sahara.

To rear *R. pravus* in the laboratory, engorged females were kept in an incubator at 25–27°F. [77–80·6°F.] until the eggs they had laid hatched. The larvae, nymphs and adults were kept at room temperature (16–23°C. [60·8–73·4°F.]) until they were fed, but the engorged larvae and nymphs were put in the incubator to moult. Rabbits and cattle were used as hosts. Under these conditions, the preoviposition period was 4–6 days, the egg stage lasted 28–33 days, the larvae, nymphs and adults engorged in 4–8, 5–11 and 7–19 days, and the engorged larvae and nymphs moulted in 7–12 and 16–19 days. A table is given showing the localities and hosts from which *R. pravus* has been recorded under various other names and the authority for each record. It is a tick of relatively dry country but is widely distributed in Africa, and its numerous hosts include cattle, sheep, goats and camels. As *R. neavei*, it was shown experimentally to be able to transmit *Theileria parva* (East coast fever of cattle) [**36** 213–214], but it usually occurs where the disease is not found and so does not seem to act as a permanent reservoir in nature. This may be due to the fact that the larvae and nymphs normally feed on small rodents.

Gregson (J. D.). **Experiments on oral Secretion of the Rocky Mountain Wood Tick,** *Dermacentor andersoni* **Stiles (Acarina: Ixodidae).**—*Canad. Ent.* **89** no. 1 pp. 1–5, 3 figs., 5 refs. Ottawa, 1957.

An account is given of a method by which an adult of *Dermacentor andersoni* Stiles, removed from its host during engorgement, can be induced to secrete an oral fluid into a capillary tube. The tube is tapered to an annealed orifice, which is slid over the hypostome and serves to separate the palps and push back the cheliceral sheath to the position it has when the tick is attached to a host. In view of the possibility of a relationship between the fluid and the production of tick paralysis, which is common in cattle and sometimes affects man in British Columbia [*R.A.E.*, B **32** 80; **33** 73; **35** 8], a study was made of its secretion in various circumstances. The ticks were detached immediately before use, and were kept at 30–35°C.

[86–95°F.]. As they sometimes withdraw some or all of the fluid after its secretion has ceased, the tubes were removed as soon as they began to do so to prevent loss. Secretion before stimulation by the tube occurred only while a detached portion of the host's skin remained round the mouthparts. It was found that the average amount of fluid produced increased as the tick engorged. The largest amounts came from fast-feeding (mated) females [cf. **33** 74] on the fifth and sixth days of feeding. The largest amounts from slow-feeding (unmated) females were obtained between the seventh and eighth days. The average amounts secreted by mated and unmated females were similar in those weighing up to 200 mg., but larger mated ticks occasionally produced more than those that were unmated. The amount produced by individuals varied widely, and the variation was not related to the size of the tick at the time the fluid was secreted or to its size before feeding. After a tick, mated or unmated, had neared repletion or passed the eighth day of feeding, the amount of fluid secreted usually diminished rapidly.

These results suggest that tick paralysis is caused by the fluid, since it usually appears only after a tick has been engorging for four days or more, individual ticks seem to vary in their ability to produce it, it can apparently be produced by either slow- or fast-feeding ticks, and it disappears when the feeding tick is removed and occasionally even when it is still attached but is near repletion. Attempts to produce paralysis by injecting the fluid into lambs, mice, a dog and a frog and frog nerve-muscle preparations were, however, unsuccessful.

Moorefield (H. H.). **Improved Method of harvesting House Fly Heads for Use in Cholinesterase Studies.**—*Contr. Boyce Thompson Inst.* **18** no. 10 p. 463, 1 ref. Yonkers, N.Y., 1957.

As the heads of house-flies (*Musca domestica* L.) are rich in cholinesterase, they have become a popular source of the enzyme for studies of the mode of action of phosphorus insecticides. Mass rearing of the flies is easy, but their individual decapitation is time-consuming, and a quicker and simpler method of separating their heads is described. The flies are frozen at −10°C. [14°F.] and shaken in a closed container or ground together lightly with the hand on a rough surface to separate the body divisions and appendages. The parts are then sifted in a sieve that retains the thoraces and abdomens, and the wings are then removed by a gentle air stream and the legs by the use of a finer sieve. Alternatively, the whole process can be carried out in one operation in a cold room by the use of appropriate nested brass sieves. The inclusion of irregular, hardened objects in the uppermost container with the intact flies facilitates decapitation. Several thousands of heads can be separated in a few minutes by this method, the specific activity of the cholinesterase is not affected by the freezing, and the heads can be stored below 0°C. [32°F.] for a week without loss of activity.

Murray (M. D.). **Observations on the Biology of Calliphorids in New Zealand.**—*N. Z. J. Sci. Tech.* **38** (A) no. 1 pp. 103–108, 1 graph, 5 refs. Wellington, N. Z., 1956.

Trapping to provide data on the seasonal incidence and habitat preferences of Calliphorids in New Zealand was carried out at Wallaceville, near Wellington, from June 1950 to December 1953. Six traps were used, some in bush and some in open pasture, during the first year, and two traps, one in bush and one in pasture, from July 1951 onwards. All were baited with fresh sheep's liver and water. The trapping period was one week, and collections were made every 3–5 weeks throughout the year. When catches were too large for the whole to be counted, quarter samples were taken, but the whole catch was examined for uncommon species. Ten identified species of Calliphorids, some unidentified species of *Pollenia* and five species of flies of other families were taken. More flies were caught in bush than in pasture and in summer than in winter.

Blowfly strike of sheep can be initiated in New Zealand by two species, the viviparous *Calliphora stygia* (F.), of which *C. laemica* (White) has been found to be a synonym, and the oviparous *Lucilia sericata* (Mg.) [*R.A.E.*, B **28** 140; **32** 142]. *C. stygia*, like *C. rufipes* Macq., *C. quadrimaculata* (Swed.), *C. icela* (Wlk.) and *C. vicina* R.-D. (*erythrocephala* (Mg.)), was caught throughout the year, whereas *L. sericata* and *Chrysomyia rufifacies* (Macq.) were not taken in winter. Seasonal fluctuations in catches of the first four and *L. sericata* in pasture and bush are shown in graphs. The species taken in greatest numbers were *Calliphora quadrimaculata* and *C. icela*. The former occurred in considerable numbers in winter, the latter had a more distinct summer peak. Neither showed any preference between bush and pasture. *C. rufipes* and *C. stygia* both showed preference for bush and *L. sericata* for pasture. *L. sericata* first appeared in spring, but was not caught in appreciable numbers until the early summer. *C. vicina* was relatively scarce, and *Chrysomyia rufifacies* had a very short season, with a peak in late summer. Infestation of sheep by blowflies occurs chiefly in spring and early summer, when crutch strike predominates, and in autumn, when body strike may predominate. Blowfly populations are low in winter, and shearing renders the sheep unattractive in summer until the fleece has grown again. *C. stygia* may cause some strike throughout the winter and is the most important species in early spring. *L. sericata* becomes important only late in the season. It has been observed in an area in which *C. stygia* is the most important species that body strike occurs mostly in pasture containing scrub. This is probably due partly to the preference of *C. stygia* for such situations and partly to the existence in them of conditions of humidity that favour the development and maintenance of attractive conditions of the fleece.

STEINHAUS (E. A.) & SMITH (R. F.). Ed. **Annual Review of Entomology. Volume 3.**—9 × 6 ins., viii + 520 pp., illus., many refs. Palo Alto, Cal., Annual Reviews, Inc., 1958.

The reviews in this third volume of a series [*cf. R.A.E.*, B **45** 27, 50], all of which are noticed elsewhere [A **46** 255], include: **Hybridization and Speciation in Mosquitoes,** by L. E. ROZEBOOM & J. B. KITZMILLER (pp. 231–248, 64 refs.); **The Feeding Habits of Biting Flies and their Significance in Classification,** by J. A. DOWNES (pp. 249–266, 139 refs.), in which the food requirements and habits of feeding (on sources of sugar as well as the body fluids of vertebrates or insects) of mosquitos, Simuliids, Ceratopogonids, Psychodids, Blepharocerids, Tabanids and Rhagionids are reviewed, and their phylogenetic significance is discussed; and **Insecticides for Control of Adult Diptera,** by R. W. FAY & J. W. KILPATRICK (pp. 401–420, 153 refs.), in which the principal groups considered are mosquitos, *Musca domestica* L. and blood-sucking flies (including *Glossina*) and the subject-matter is divided into sections on evaluation of control, fly control in structures, fly control on animals and area control.

HORSFALL (W. R.). **A Method for making a Survey of Floodwater Mosquitoes.**—*Mosq. News* **16** no. 2 pp. 66–71, 10 figs., 4 refs. Albany, N. Y., 1956.

Plans for the control of flood-water mosquitos (*Psorophora* and *Aëdes*) in the United States should be based on surveys of the distribution of their eggs, because these are present for the greater part of the year in recognisable, restricted sites, whereas the later stages, especially the adults, disperse widely. The eggs are found only in areas subject to transient flooding and are generally in or under plant débris or plastered to the sides of cracks or holes. A dependable means of sampling for eggs has been devised and is described. It consists essentially of collecting samples of surface débris, screening them through a series of screens to remove coarse matter, floating the remainder and identifying the eggs microscopically.

GJULLIN (C. M.) & PETERS (R. F.). **Tests with aerial Sprays of Malathion for the Control of Mosquitoes.**—*Mosq. News* **16** no. 2 pp. 84–86, 7 refs. Albany, N. Y., 1956.

The following is substantially the authors' summary. An experiment was carried out in August 1955 on the application from aeroplanes of malathion in an oil spray at 0·47 lb. per acre, over an area two miles square in central California, for the control of adults of *Culex tarsalis* Coq. The effect on adults and larvae of *Aëdes nigromaculis* (Ludl.) was also observed. Light-trap collections indicated that the insecticide caused 51 and 97 per cent. reduction of females of *C. tarsalis* and *A. nigromaculis*, respectively. Collections in buildings indicated a 38 per cent. reduction in females of *C. tarsalis*. Complete kills of larvae of *A. nigromaculis* occurred in open water but not in water that was heavily covered with vegetation.

Filter papers exposed in four fowl houses contained 0·9 µg. malathion per sq. inch, whereas those exposed in the open near the houses contained 49·4 µg. The average of all the papers exposed in the open, including those near the fowl houses, was 30·27 µg.

GAHAN (J. B.), BERTHOLF (J. H.), DAVIS jr. (A. N.) & SMITH (C. N.). **Field Tests with two Phosphorothioates against resistant Salt-marsh Mosquitoes.**—*Mosq. News* **16** no. 2 pp. 91–93, 2 refs. Albany, N. Y., 1956.

The following is mainly based on the authors' summary. Solutions of malathion in fuel oil, with cyclohexanone as an auxiliary solvent, were applied from an aeroplane at 0·1, 0·25 or 0·5 lb. malathion per acre to marsh and residential areas in Florida heavily infested with adults of *Aëdes*, predominantly *A. sollicitans* (Wlk.) and at 0·1 lb. to a palm grove infested mainly with *A. taeniorhynchus* (Wied.). The mosquitos were highly resistant to chlorinated-hydrocarbon insecticides. All treatments reduced their numbers by over 99 per cent. in six hours, except in the palm grove, where the reduction was 95 per cent. The tests were made in October, against mosquitos that had developed slowly because of cool weather, and may not be indicative of the control that would be obtained with the same dosages in summer. Applications from an aeroplane of granules containing Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate] at 0·05–0·1 lb. insecticide per acre gave 90–99 per cent. control of larvae of the same species (predominantly *A. sollicitans*) in salt-marshes, whereas BHC granules at 0·1–0·2 lb. γ isomer were ineffective.

PINTO SEVERO (O.). **Eradication of the** *Aedes aegypti* **Mosquito from the Americas.**—*Mosq. News* **16** no. 2 pp. 115–121, 1 map. Albany, N. Y., 1956.

The discovery of jungle yellow fever in South America led to the belief that the only means of protecting urban populations from the disease was the eradication of *Aëdes aegypti* (L.) [*cf. R.A.E.*, B **38** 91]. The chief difficulties in the way of eradication from Brazil were found to be the extent to which the mosquito had spread into rural areas and the very long time (more than a year) that the eggs can survive desiccation, but its eradication from the whole continent of America was envisaged after the discovery of DDT. Extensive spraying against the adults was impracticable, and in 1948 the " perifocal " control method was adopted. This consists in applying a spray containing 3–5 per cent. DDT to the inside and outside of all possible breeding sites, whether or not they contain water, and to a section of the nearby wall, to destroy both larvae and females seeking to oviposit. One such treatment eliminates *A. aegypti* from villages of less than 1,000 houses, where there is generally no problem of hidden or inaccessible foci, two applications during a year are adequate for large ones (1,000–5,000 houses), and four applications to all infested points at intervals of three months are effective in towns and cities of over 5,000 houses. The technique allows of great simplification of complementary services. The criterion of eradication for urban areas should be the confirmation of the absence of the mosquito for at least a year by at least two surveys, but one negative search for foci in all houses at least one year after the finding of the last focus is considered adequate in rural areas.

The state of the campaign at the end of 1955 is shown on a map and discussed. The vast area in eastern and north-eastern Brazil that had been treated with oil for many years was shown to be almost clear in 1952, after four years of systematic work with DDT, and only the final negative surveys were lacking to prove eradication throughout the country in 1955. Bolivia was freed of the mosquito in 1948 [**42** 159] and French Guiana in 1952 [**44** 200]. Chile, Ecuador [*cf.* **41** 170], British Guiana [*cf.* **43** 142; **44** 27], Paraguay, Peru and Uruguay were in the final stages of eradication. A nation-wide campaign was being organised in Argentina, and work was continuing in Colombia and Venezuela. Dutch Guiana was the only South American country in which the campaign had not begun. Panama, Nicaragua, Costa Rica, Honduras and British Honduras were in the final stages of eradication, and Salvador and Guatemala were expected to be so by the end of 1956. Eradication was believed to have been attained in the Panama Canal Zone. The situation in the Greater Antilles was not satisfactory, and the campaign had only recently begun in most of the islands of the Lesser Antilles, where work was in progress in ten of the 13 archipelagos. The campaign in Mexico was interrupted in 1955 but was to be resumed. No eradication campaign had been initiated in the United States, although an area that includes part or all of 13 States is considered receptive to yellow fever by the United States Public Health Service.

GILLETTE (H. P. S.). **Yellow Fever in Trinidad—a brief Review.**—*Mosq. News* **16** no. 2 pp. 121–125, 7 refs. Albany, N. Y., 1956.

The history of the occurrence of yellow fever in Trinidad is reviewed with special reference to the outbreak in 1954 [*R.A.E.*, B **45** 100–101] and the measures taken to combat the disease. Proposals for the eradication of *Aëdes aegypti* (L.) [*cf.* preceding abstract] had been put forward in 1948–50, and though they had been rejected, a token scheme was carried out in and around Port of Spain. All water containers both outside and inside premises were treated with DDT at the recommended dosage [1 part per million], but this failed to give complete mortality or prevent fresh breeding. After the outbreak of yellow fever in 1954, an island-wide treatment was made at a greatly increased dosage, and this reduced *Aëdes* indices below the critical level but still failed to give complete control in any area. Laboratory investigations confirmed that the local strain of *A. aegypti* was resistant to DDT. Larvae survived exposure to 200 parts DDT per million for 48 hours. However, laboratory tests showed that there was practically no resistance to BHC or dieldrin, and BHC was substituted for DDT with good initial results.

SNOW (W. E.) & PICKARD (E.). **Seasonal History of *Culex tarsalis* and associated Species in larval Habitats of the Tennessee Valley Region.**—*Mosq. News* **16** no. 2 pp. 143–148, 2 figs., 1 ref. Albany, N. Y., 1956.

Light-trap collections at army installations and near the reservoirs of the Tennessee Valley Authority have shown that the distribution pattern of *Culex tarsalis* Coq. differs widely from year to year, and that the mosquito occurs mainly in the autumn in the Tennessee Valley region [*cf. R.A.E.*, B **34** 166; **41** 66]. Observations on the habitats used by the larvae in this region were made in 1954 and 1955, mainly near Paris, in north-western Tennessee. They substantiated the observation that, east of the Mississippi River, *C. tarsalis* is generally present from late August to late November, with a peak in September. Evidence of at least two broods during this period was obtained in 1955. Larvae were collected from grassy seepages and intermittently flooded ditches and were most often associated with *C. pipiens* L. and *Anopheles punctipennis* (Say). In the seepages, they were found among mud plantain (*Heteranthera reniformis*) and panic grass (*Panicum dichotomiflorum*). The regularity and amount of rain in late summer and autumn may be an important factor in determining the occurrence and abundance of *C. tarsalis*, through their effect in maintaining temporary breeding places. At Florence, in north-western Alabama, larvae of *C. tarsalis* were found in excavation pits in a sewer line construction area in September 1954, but did not appear in nearby polluted backwater pools of a lateral drain on an arm of the reservoir until November. In general, *C. tarsalis* favoured small pooled areas such as grassy ditches, seepages, hoofprints and polluted pools rather than larger and more permanent bodies of fresh or polluted water. It was not found in leafy pools of rocky stream beds.

NOTANANDA (V.). **Spirochaetal Infections of salivary Glands of Mosquitoes.**—*Mosq. News* **16** no. 2 p. 150, 3 refs. Albany, N. Y., 1956.

Spirochaetes have been found in larvae and adults of many species of mosquitoes, and in the salivary glands of females of *Anopheles maculipennis atroparvus* van Thiel [*R.A.E.*, B **27** 232], *A. funestus* Giles [**44** 12] and *A. gambiae* Giles [**44** 140]. During a malaria survey in the mountains of northern Siam in 1954, a female of *A. jeyporiensis candidiensis* Koidz., taken in a dwelling house, was found to have a large number of living spirochaetes in its salivary glands. The spirochaetes, the measurements of which are given, were similar in size and shape to those recorded from *A. m. atroparvus* [**27** 232]. Their possible pathogenicity for man or animals could not be studied. Malaria was hyperendemic in the area, but relapsing fever has not been found there.

Lacour (M.) & Rageau (J.). **Enquête épidémiologique et entomologique sur la filariose de Bancroft en Nouvelle-Calédonie et dépendances.**—[*Tech. Pap. S. Pacif. Comm.*] no. 110, [3 +] 24 pp., 1 map, 5 pp. refs., multigraph. Nouméa, 1957. (With a Summary in English.)

Records of filariasis caused by *Wuchereria bancrofti* in New Caledonia are briefly reviewed. Surveys in 1955 and 1956 indicated that its distribution there was confined to coastal areas, and that it occurred on some, but not all of the Loyalty Islands and was absent from the Isle of Pines. The endemic areas and the microfilaria rates are shown on a map. The microfilariae were of the non-periodic type, and clinical manifestations of filariasis were rare and slight [*cf. R.A.E.*, B **42** 85].

Investigations on possible vectors, carried out in New Caledonia in 1956, revealed the presence of nine species of mosquitos of potential importance because of their association with man. They included *Aëdes aegypti* (L.), which was not further studied, as it is probably of fairly recent introduction and is confined to ports, and was taken only in small numbers. Notes are given on the local bionomics of the other eight, which comprised *A. vigilax* (Skuse), *A. vexans nocturnus* (Theo.), *A. alternans* Westw., *A. notoscriptus* (Skuse), *Culex pipiens fatigans* Wied., *C. annulirostris* Skuse, *C. sitiens* Wied., and *Mansonia* (*Taeniorhynchus*) *xanthogaster* (Edw.). They were taken resting in dwellings or attempting to bite near Nouméa and at various foci of filariasis around the coast. In all, 2,224 females of these eight species were dissected, including 1,109 of *A. vigilax*, 612 of *C. sitiens*, 233 of *C. p. fatigans* and 147 of *M. xanthogaster*. One or two filarial larvae, some of them identifiable as *W. bancrofti*, were found in 25 females of *A. vigilax*, of which 14 were infected in the head or proboscis and 11 in the thorax, unidentified larvae in the thorax of one of *C. p. fatigans*, one of *C. sitiens*, and one of *M. xanthogaster* and numerous larvae of *Dirofilaria immitis* in the Malpighian tubes of one of *C. annulirostris*. It is possible that some of the unidentified larvae found in the mosquitos were not of human origin, but rates of experimental infection obtained by M. O. T. Iyengar in one test and by Iyengar and M. A. U. Menon in another, when mosquitos taken in nature were fed on carriers of *W. bancrofti*, were so much higher than the natural rates that their infection with *W. bancrofti* was virtually certain. The natural and experimental infection rates in *A. vigilax* in the part of New Caledonia in which the first experiment was made were 5 and 57·1 per cent. *A. vigilax*, *A. notoscriptus* and *C. p. fatigans* were all infected in the second experiment, and the infection rate was 94 per cent. in *vigilax* [as compared with 95·8 per cent. in *fatigans* and 72·2 per cent. in *notoscriptus*, with normal development of the larvae in all three mosquitos]. It is concluded that *A. vigilax* is the main vector of *W. bancrofti* in New Caledonia, since *notoscriptus* is not plentiful enough to be of great importance, and man is not the chief host of *fatigans*.

A. vigilax is widespread and abundant in the coastal regions, where it breeds in brackish water in mangrove swamps, sunny pools, ditches and rock holes. The adults are particularly numerous in the hot, wet season from December to April. The females are very aggressive and attack both man and domestic animals. They do so particularly in scrub in hot, still weather, but sometimes enter dwellings to feed. They bite at all times of the day and night, with a peak about sunset. They are abundant near their breeding sites, but also fly for long distances, and it is thought that their wide dispersal may minimise repeated infections of the human host with *W. bancrofti* and so be responsible for the scarcity of serious manifestations of filariasis. No infection was found in females in a mountain village in which they were numerous, and this supports the evidence that filariasis is restricted to the coastal zone.

Colless (D. H.). **The *Anopheles leucosphyrus* Group.**—*Trans. R. ent. Soc. Lond.* **108** pt. 3 pp. 37–116, 19 figs., 3 pp. refs. London, 1956. **Further Notes on the Systematics of the *Anopheles leucosphyrus* Group (Diptera: Culicidae).**—*Proc. R. ent. Soc. Lond.* (B) **26** pt. 7–8 pp. 131–139, 6 refs. London, 1957.

In the first of these papers, the author reviews 14 species, subspecies and forms of the group of *Anopheles leucosphyrus* Dön. [*cf. R.A.E.*, B **40** 141; **44** 86]. *A. leucosphyrus* has two subspecies, *leucosphyrus* (which occurs in Borneo, Malaya and Sumatra) and *balabacensis* Baisas (Philippines, Borneo, Malaya, Java, Siam, Indo-China, Burma, India and Formosa), as well as "Luzon" and "Negros" forms (Philippines) and "Fraser's Hill" and "Kepong" forms (central Malaya). Other species recognised are *A. riparis* King & Baisas, with subspecies *riparis* (Philippines) and *macarthuri*, n. (Borneo, Malaya), *A. cristatus* King & Baisas (Philippines), *A. pujutensis* Colless (Borneo, Sumatra, Malaya), *A. elegans* (James) (India, Ceylon) and *A. hackeri* Edw. (Borneo, Malaya and possibly Sumatra). Descriptions are given of the characters of all stages of *A. l. balabacensis* and the females of all the others, the larvae and pupae of nearly all, and the males and eggs of a few. Keys are also given to the females of all the forms that can be separated in this stage and to the fourth-instar larvae of the 11 for which this stage is known. The Kepong form of *leucosphyrus* may be Crawford's type with spine 4 long and *A. r. macarthuri* is the type with spine 4 short [*cf.* **40** 142]. In addition to the above 12 forms, there are two others, one from Celebes and one from Palembang (Sumatra). The Celebes form is known only from the female, and it probably represents a distinct species. Its nearest relative appears to be *A. hackeri*, and records of *hackeri* from Celebes [*cf.* **41** 58] refer to it. The other is known only from the larva and appears to be closest to *A. l. leucosphyrus*.

A. l. balabacensis is the commonest member of the group. The differences between it and *A. l. leucosphyrus* and the marked geographic variation that occurs within each might suggest that they are separate species, but their ranges of distribution do not overlap, and intermediate populations have been found in the Malay Peninsula, suggesting that differentiation is well advanced but not yet complete. The Fraser's Hill form is apparently the Central Malayan representative of *A. l. balabacensis* and like the Kepong form, is intermediate between it and *A. l. leucosphyrus*. The fact that they are found in Central Malaya along with *A. l. leucosphyrus* suggests that in this region where the ranges of *A. l. leucosphyrus* and *A. l. balabacensis* meet, hybridisation has produced a zone of secondary intergradation in which a number of intermediate forms occur. The Luzon form is restricted to Luzon and is the only one that occurs there [*cf.* **24** 234]. The adult and pupa tend to resemble *A. l. leucosphyrus* and the larva *A. l. balabacensis*, but the pharyngeal teeth are different from those of any other form. The Negros form is possibly a local form transitional between the Luzon form and *A. l. balabacensis*, to which it bears a general resemblance.

The range of the *leucosphyrus* group extends from western India northwards to Yunnan [*cf.* **31** 215] and Formosa and eastwards to Celebes. It is limited to the east by the Wallace and Weber lines, but otherwise coincides closely with the "monsoon forest" and "tropical rain forest" vegetational types. All forms haunt primary and secondary forest or man-made plantations and are absent from open country. The typical breeding place of *A. l. balabacensis*, which is described in detail, is a small pool or group of pools in clay soil, with fairly clean seepage or rain-water, still or with very slight flow, and under some shade. Direct sunlight between 9 a.m. and 3 p.m. appears to inhibit breeding. The pools are often made by man or animals and are temporary in character. Of the remaining forms, *A. l.*

leucosphyrus, *A. pujutensis* and the Celebes form have breeding places like those of *A. l. balabacensis*, while the others occupy more specialised niches. The results of removing shading vegetation from around breeding places of *A. l. balabacensis* are described, and it is shown that the subsequent disappearance of breeding is gradual [*cf.* **43** 93] and not due to any direct effect of light on the ovipositing female. Notes are given on the collecting and rearing of larvae and also observations suggesting that larvae, in nature, are rather insensitive to pH and light conditions.

The adults of all members of the group rest out of doors by day. Several resting sites of *A. l. balabacensis* in a rubber plantation and in secondary jungle in North Borneo are described. The feeding peak of *A. l. balabacensis* occurs after midnight. Unfed females tend to congregate on foliage, etc., outside houses quite early in the night and rest there for long periods, before entering the houses. About half of those that enter rest on the walls before feeding, and almost all do so after feeding. The resting period after feeding appears to increase as the night progresses and may be as long as three hours [*cf.* **43** 7]. There are noticeable tendencies for attacks to come in waves and for outdoor catches to be correlated with moonlight. The adult behaviour of *A. l. leucosphyrus*, so far as is known, is virtually identical with that of *A. l. balabacensis*. From pooled information on the feeding cycle in the two subspecies, it appears that the initial activation to flight activity may be a release from the inhibiting effect of light, and that the mosquito first flies at random or is orientated by physical factors, such as wind currents. Direct orientation, by and towards the host, seems to operate over short distances only, and it appears that unfed females found resting near the host have been inactivated by their initial contact with vapours emanating from it. During the resting period, they are re-activated to an extent that causes feeding. After feeding, the engorged females must rest again until they have been sufficiently activated to allow them to leave. Mechanisms that might produce this course of events are discussed, and the general hypothesis is shown to explain most of the known facts, including the tendency to attack in waves. There is strong evidence that both subspecies of *A. leucosphyrus* prefer human blood and the Celebes form also attacks man. *A. hackeri*, *A. pujutensis* and *A. riparis* all show complete indifference to or aversion from human bait. Adult densities of *A. l. balabacensis* are correlated with rainfall, because of the nature of its breeding places and the effect of humidity on adult survival. Sporozoite rates also tend to increase in wet weather. The known vectors of human malaria are *A. l. balabacensis* in North Borneo, Burma, Assam and Indo-China, *A. l. leucosphyrus* in Sarawak, Sumatra and almost certainly in Indonesian Borneo, and the Celebes form in Celebes and adjacent islands [*cf.* **41** 58]. Other forms of *A. leucosphyrus*, *sens. strict.*, may be vectors, but the remaining members of the group are almost certainly harmless.

Changes in the status accorded to the forms of *A. leucosphyrus* are made in the second paper as a result of studies of further collections of the Kepong form in Malaya. These revealed the occurrence in Central Malaya of mixed populations of *A. l. leucosphyrus* and the Kepong form, in which there was no evidence of morphological intergradation. Moreover the progeny of two females of each form bred true, and there was no abnormal variability in the Kepong form, such as would be expected if it were produced by hybridisation of *A. l. leucosphyrus* and *A. l. balabacensis*. The latter is therefore accorded specific status, and the Keepong form classed as a subspecies of it and named *A. b. introlatus*, n.

The amount of material available was inadequate to clarify the status of the Fraser's Hill form (which might be a distinct altitudinal subspecies or species, or a phenotypic variant produced by growth at high altitudes) or the Negros form, but the Luzon form is accorded subspecific status and named *A. b. baisasi*, n. Its characters made it difficult to decide whether it should be allocated to *A. balabacensis* or to *A. leucosphyrus*, but geographical distribution suggests that it was derived from *balabacensis* (or an undifferentiated parent stock) in parallel with *leucosphyrus*.

Descriptions are given of the characters of the females, larvae and pupae of *A. leucosphyrus* and *A. balabacensis* subspp. *balabacensis*, *introlatus* and *baisasi*.

BELLAMY (R. E.). **An Investigation of the taxonomic Status of** *Anopheles perplexens* **Ludlow, 1907.**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 515–529, 6 figs., 47 refs. Washington, D. C., 1957.

The literature on the status of *Anopheles perplexens* Ludl. and records that certainly or probably refer to the mosquito so described are reviewed, and an account is given of studies as a result of which it is concluded that it is a valid species. The name is accordingly removed from the synonymy of *A. punctipennis* (Say), with which *perplexens* has generally been confused. The material examined in the present study was mainly from Georgia and was found to fall into two groups. The adults of one group were larger, had brighter wings, were generally lighter in colour, and are believed to belong to the species to which Say's original description of *punctipennis* refers. The adults of the other group are smaller and darker and the large light costal spot of *punctipennis* is quite small or almost lacking. It is relatively certain that the type of *perplexens* is an extremely melanistic specimen of this form. Accordingly the two forms are treated as *punctipennis* and *perplexens*, respectively. Their eggs were found to show striking differences that provide the most reliable means of separating them; and on the basis of identification of eggs, the two forms were reared separately and the fourth-instar larvae, pupal exuviae and adults are compared. They were found to be extremely similar morphologically, but hair 2 on abdominal segments IV and V in fourth-instar larvae was predominantly single in *perplexens* and generally branched in *punctipennis*. No reliable differences were detected in an examination of the mouth-parts, fore-legs and genitalia of representative adults of both sexes of the two forms.

While *punctipennis* is widespread and is probably the most abundant Anopheline in eastern North America, and appears to develop in a considerable variety of temporary and permanent water, including flood-plain pools, turbid wallows and roadside puddles, ditches and stream edges, *perplexens* seems to be practically restricted to limestone springs and the streams that they form. Such springs are particularly plentiful in southern Georgia and northern and central Florida, and the two mosquitos occur there in different types of breeding places with only slight ecological overlapping, in that larvae of the *punctipennis* type are occasionally found in the calcareous water. *A. perplexens* was originally described from Pennsylvania, and there are records of melanistic adults of *A. punctipennis* and larvae with simple antepalmate hairs on segments IV and V from Tennessee and North Carolina. It is probable that an examination of clear limestone springs throughout the eastern United States would show that *perplexens* is widely distributed. In any case, *perplexens* and *punctipennis* occupy a considerable area in common and appear therefore to be sympatric species. No intermediate types of eggs or mixed batches of eggs were seen. Larvae of *perplexens* developed satisfactorily in the laboratory only when calcareous water was used, and *punctipennis* larvae developed better in this water than in tap water, although they could be satisfactorily reared in the latter.

Galindo (P.), Trapido (H.), Carpenter (S. J.) & Blanton (F. S.). **The Abundance Cycles of arboreal Mosquitoes during Six Years at a Sylvan Yellow Fever Locality in Panama.**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 543–547, 1 graph, 8 refs. Washington, D. C., 1957.

The following is mainly based on the authors' summary. The data here summarised are based on six years' collections of forest-canopy mosquitos in an area some 15 miles east of the Panama Canal, through which jungle yellow fever passed late in 1948 [*R.A.E.*, B **45** 9] and in which the vegetation cover is transitional between tropical deciduous forest and tropical rain-forest. They show that there are substantial year-to-year fluctuations in rainfall and correspondingly great fluctuations in the densities of the arboreal mosquitos known or suspected to be vectors of yellow fever. These are *Haemagogus equinus* Theo., *H. regalis* D. & K. (*lucifer* (H., D. & K.)), *H. spegazzinii falco* Kumm, Osorno & Boshell, *Aëdes leucocelaenus clarki* Galindo, Carpenter & Trapido and *Sabethes chloropterus* (Humb.). There is no direct evidence implicating *H. regalis*, but it appears likely that any species of *Haemagogus* can transmit the disease under suitable conditions. During the dry season, which is well marked, arboreal mosquitos become rare, but the variation in mosquito populations is such that some of the vector species can be found during each of the four months of the dry season (January–April) in some years. A tendency to less marked vertical stratification of the arboreal mosquito fauna in the dry season, when leaf loss is greatest and the difference between the microclimate in the canopy and at ground level is least marked, means that these mosquitos are actually not quite so scarce as the canopy catches appear to indicate. *S. chloropterus* was the only known or suspected vector taken in the canopy during all months in any one year [*cf.* **41** 79–80]. *H. s. falco* and *A. l. clarki* were never taken in the four dry months.

March (R. B.) & Lewallen (L. L.). **Paper Chromatography of fresh Tissue Extracts of susceptible and insecticide-resistant Strains of the House Fly,** *Musca domestica* **L.**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 571–575, 1 fig., 18 refs. Washington, D. C., 1957.

The following is based on the authors' summary and discussion. Four susceptible and five insecticide-resistant strains of the house-fly (*Musca domestica* L.) and strains of *Fannia canicularis* (L.) and *Lucilia* (*Phaenicia*) *sericata* (Mg.) were examined by means of paper chromatography of fresh tissue extracts. A number of differences in the chromatographic patterns of the nine strains of the house-fly were found, but none of these differences could be directly correlated with susceptibility or resistance. Instead, they seemed to be correlated with the origin of the strain. The study supports other work on the heterogeneity of both susceptible and resistant strains and the independent nature of various characteristics unrelated to resistance [*R.A.E.*, B **42** 189–190]. It also suggests an explanation of the results of Bigelow & LeRoux, who recorded morphological differences between various strains susceptible and resistant to DDT [**43** 163–165] but were not aware that strain Methoxychlor, which had been developed by selection with methoxy-DDT from the susceptible strain that they designated California, had concurrently developed a high level of resistance to DDT. Thus the characters of Methoxychlor were associated with its origin and not with its supposed susceptibility to DDT.

The need for caution in interpreting results of taxonomic studies with chromatographic techniques was shown by the fact that chromatographic patterns as distinct as those separating the three different species of flies were found among the nine strains of *M. domestica*.

MICKS (D. W.). **Paper Chromatography in Insect Taxonomy.**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 576–581, 4 figs., 23 refs. Washington. D. C., 1957.

The following is virtually the author's summary. Paper-chromatographic methods were applied to whole specimens as well as extracts of Hemiptera (*Triatoma gerstaeckeri* (Stål) and *T. infestans* (Klug)), Orthoptera (*Periplaneta americana* (L.), *Blattella germanica* (L.) and *Supella supellectilium* (Serv.)) and Diptera (*Culex pipiens pipiens* L., *C. p. molestus* Forsk.. *C. p. fatigans* Wied., *Aëdes aegypti* (L.) and *Anopheles quadrimaculatus* Say). One-dimensional chromatograms revealed qualitative differences between the three orders in their patterns of ninhydrin-positive substances. The three genera of mosquitos could be readily distinguished by marked quantitative differences in their amino-acid levels. Chromatograms of larvae and adults of *C. p. molestus*, *C. p. fatigans* and *A. quadrimaculatus*, although similar, showed quantitative differences in their ninhydrin-positive materials [*cf. R.A.E.*, B **44** 81–82]. The two sexes gave essentially the same chromatographic patterns. *C. p. fatigans*, *C. p. pipiens* and *C. p. molestus*. as well as *Aëdes aegypti*, had qualitatively different chromatograms of fluorescent substances. Paper chromatography can be applied comparatively to whole insect specimens or to parts of specimens without the use of any special equipment. Both the ninhydrin-positive and the fluorescent patterns can be used in resolving taxonomic problems.

GIANNOTTI (O.), METCALF (R. L.) & MARCH (R. B.). **The Mode of Action of Aldrin and Dieldrin in** *Periplaneta americana* **(L.).**—*Ann. ent. Soc. Amer.* **49** (1956) no. 6 pp. 588–592, 12 refs. Washington, D. C., 1957.

The following is virtually the authors' summary. Preliminary studies were carried out on the mode of action of aldrin and dieldrin in *Periplaneta americana* (L.). The compounds were nearly equitoxic, and their respective 120-hour LD50 values in μg. per g. body weight were 1·9 and 1·3 by topical application and 1·5 and 1·1 by injection. This indicates that they are very effectively absorbed and transported to the site of action. The symptoms of poisoning produced by them arise from stimulation of the central nervous system and are antagonised by the action of nicotine. Unlike DDT, they do not produce symptoms in isolated legs. This indicates an absence of activity on structures peripheral to the central ganglion. Experiments by the paper-chromatographic technique, bioassay with mosquito larvae and colorimetric determination of aldrin and dieldrin indicate that aldrin administered to cockroaches is partly converted to dieldrin [*cf. R.A.E.*, A **46** 99].

PETERSON (H. O.), JONES (E. M.) & CORBETT (N. G.). **Effectiveness of Dow ET-57 (Trolene) against the Nasal Botfly of Sheep.**—*Amer. J. vet. Res.* **19** no. 70 pp. 129–131, 1 fig., 2 refs. Chicago, Ill., 1958.

In New Mexico, 90–95 per cent. of adult sheep and a somewhat smaller proportion of lambs are thought to be infested at some time with *Oestrus* *ovis* L. The method of treatment in use (injection of a 3 per cent. solution of saponified cresol into the nasal cavity) can destroy 95–98 per cent. of first-instar larvae, but its proper application is troublesome and requires special equipment [*R.A.E.*, B **29** 78], and the effectiveness of a much simpler method was therefore investigated. It consists of administering an undiluted 50 per cent. emulsifiable concentrate of Dow ET-57 (purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate) as a drench to act as a systemic insecticide. A single treatment at 100 mg. active ingredient per kg. body weight was given to 21 naturally infested aged ewes, and 28 similar infested ewes were kept as controls. All the first-instar larvae in all but one of the treated ewes were found dead when the animals were killed 3–4 days after treatment. The ewe in which treatment was ineffective was suffering from diarrhoea not attributable to the treatment. There were 116 first-instar larvae in this ewe and 1,769 in the 28 untreated ones. The treatment at the dosage used was ineffective against the second and third instars. It appears that the best time to administer it would be autumn or early winter [*cf. loc. cit.*]. No ill effects attributable to the drug were observed in any of the treated ewes (which also included seven that were not infested). The treatment is not yet recommended for general use but is thought worthy of provisional trial.

Gailiunas (P.). **Effects of Hypotonic and Hypertonic Sodium Chloride Solutions on first-instar** *Hypoderma lineatum* **Larvae.**—*Amer. J. vet. Res.* **19** no. 70 pp. 237–239, 11 refs. Chicago, Ill., 1958.

Typical results are given of *in vitro* tests in which some hundreds of first-instar larvae of *Hypoderma lineatum* (Vill.), isolated from the gullets of cattle slaughtered 2–3 hours earlier in Michigan, were immersed in tap water or in 0·55–1·8 per cent. solutions of sodium chloride or 10 per cent. dextrose in saline solution until they became motionless. Before and after exposure, the larvae were kept in Ringer's solution. It was apparent from the results that the body wall of the larva acts as a semipermeable membrane, which readily allows water molecules to pass through it in either direction but prevents the passage of larger particles such as sodium and chlorine ions. Survival times were variable but indicated that, in hypertonic solutions, the time needed to kill the larvae was directly proportional to their size and inversely proportional to the salt concentration and temperature of the solution. These facts suggest that the younger the larvae, the more they might be susceptible to changes in the osmotic pressure of the body fluids of the host, with which those of the larvae are thought to be normally in equilibrium.

Investigations are suggested into the possibility of temporarily increasing the osmotic pressure of the body fluids of the host by the oral or parenteral administration of sodium chloride to a degree that would destroy the larvae. It is known that cattle that are not restricted in their water intake can ingest a relatively high dosage of common salt without showing marked signs of intoxication, and that the marked increase in concentration of chlorides in their blood remains for many hours. Moreover, since larvae of *H. lineatum* accumulate in the oesophagus and perioesophageal tissues for several weeks at one period of the year, it might be practicable to destroy them by infiltrating the cervical region with strong sodium-chloride solutions. The synergistic effectiveness of large doses of salt together with an insecticide should also be investigated.

MITLIN (N.), BUTT (B. A.) & SHORTINO (T. J.). **Effect of Mitotic Poisons on House Fly Oviposition.**—*Physiol. Zoöl.* **30** no. 2 pp. 133–136, 1 pl., 14 refs. Chicago, Ill., 1957.

The sterilisation of males of *Callitroga hominivorax* (Coq.) by X-rays and γ-rays [*R.A.E.*, B **40** 43; **42** 38] suggested the possibility that similar effects might be produced chemically. An investigation was therefore made of the effect on the fertility of adults of both sexes of the house-fly (*Musca domestica* L.) of feeding them, from the time they emerged, on diluted skimmed milk containing poisons known to affect mitosis in other organisms. The poisons were the sodium salt of aminopterin (4-aminopteroyl glutamic acid), colchicine, podophyllotoxin and a nitrogen mustard, methyl bis-(β-chloroethyl)amine hydrochloride, and they were administered at concentrations of 0·2, 0·5, 0·8 and 2 mg. per ml., respectively. Treated flies of one sex were allowed four hours to pair with untreated flies of the other when they were three days old, and the females were then returned to their previous diet to complete the preoviposition period. None of the poisons affected the males, since the females paired with them laid normal eggs, and podophyllotoxin had no apparent effect on the females, but those given the other three poisons did not oviposit, and dissection showed that ovarian development had been inhibited. The eggs in the ovaries of aminopterin-treated flies contained less yolk than did those of normal flies; other structures appeared to be the same except for size.

Neither folic acid (as its sodium salt) nor thymidine reversed the action of aminopterin when administered with or after it [*cf.* **43** 157]. Females fed on a 5 per cent. aqueous solution of sucrose did not oviposit, but they began to do so two days after skimmed milk was substituted for it, whereas flies given untreated milk after they had been fed on one of the three mitotic poisons did not become gravid and oviposit. Viable eggs were laid by females mated to males fed on sucrose.

ROULSTON (W. J.). **The Effects of some Chlorinated Hydrocarbons as Systemic Acaricides against the Cattle Tick,** *Boophilus microplus* **(Canestrini).**—*Aust. J. agric. Res.* **7** no. 6 pp. 608–624, 6 graphs, 28 refs. Melbourne, 1956.

The following is based on the author's summary of experiments in southern Queensland in which various organic compounds were tested as systemic acaricides against *Boophilus annulatus microplus* (Can.) on cattle. In the main series of tests, solutions of the compounds in groundnut oil were injected subcutaneously into cows at a dosage (except for endrin and isodrin) of 25 mg. toxicant per kg. body weight. Dieldrin, aldrin and γ BHC (lindane) markedly reduced the numbers of ticks present on the cows at the time of treatment, though many developed to maturity, and had a striking effect in preventing the establishment of larvae. On an average, the cows treated with γ BHC remained free from larvae from the seventh to the 22nd day after injection and those treated with dieldrin from the 12th to the 25th day. Numbers were very small on the aldrin-treated cows from the 16th to the 27th day. Dieldrin and aldrin continued to affect the reinfesting ticks even after they were able to establish themselves as larvae, and the first appearance of each succeeding stage in the life-cycle was progressively postponed. The average periods between injection and the first persistent reinfestation by young adult ticks were 43, 67 and more than 80 days for cows treated with γ BHC, dieldrin and aldrin, respectively. In three out of four experiments, γ BHC was detected in the hair of treated cattle, but none could be detected in skin and blood samples.

Toxaphene, diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], malathion and p,p′DDT had no effect on the ticks, and no DDT could be detected in skin, hair or blood samples. Similarly, isodrin, injected at 5, 10 and 15 mg. per kg., was ineffective, as was endrin at 5 mg. Two animals received injections of 10 and 15 mg. endrin per kg. and both died. Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate], which is not soluble in groundnut oil, was administered orally in gelatine capsules at dosages of up to 50 mg. per kg., but was also ineffective.

Four cows were used to test the effect of applying groundnut-oil solutions of the toxicants (again at 25 mg. per kg.) by rubbing them on the back of the neck where the animal could not lick. Applied in this way aldrin and DDT were ineffective, but dieldrin and γ BHC resulted in marked mortality of ticks over the entire body region, which suggested penetration of the skin and systemic effect. The cow treated with γ BHC was free from larvae from the third to the 11th day after treatment, and the one treated with dieldrin from the third to the 21st day.

DAVIS (G. E.). **The Identification of Spirochetes from human Cases of Relapsing Fever by Xenodiagnosis with Comments on local Specificity of Tick Vectors.**—*Exp. Parasit.* **5** no. 3 pp. 271–275, 4 refs. New York, N. Y., 1956.

Borrelia persica, *B. crocidurae* (*microti*) and *B. latyschewi*, which are transmitted by *Ornithodoros tholozani* (Lab. & Mégn.), the small form of *O. erraticus* (Lucas) and *O. tartakovskyi* Olen., respectively, can be differentiated in guineapigs, which are highly susceptible to the first, slightly susceptible to the second and not susceptible to the last, but cannot be identified by xenodiagnosis because the local specificity of the vector relationships of *B. persica* and *B. crocidurae* is so intense that a strain from one area is not transmitted by a strain of its vector from another [*cf. R.A.E.*, B **44** 108–110, 201–202]. However, xenodiagnosis has to be used for the identification of *B. hermsi*, *B. turicatae* and *B. parkeri* in the United States, as guineapigs have been shown to be susceptible to all three, although a strain of *B. hermsi* has recently been found to which they are not susceptible. Tick-borne relapsing fever is present in at least 13 of the western States, where there are four known tick vectors, *O. hermsi* Wheeler, *O. turicata* (Dugès), *O. parkeri* Cooley and *O. talaje* (Guér.), although the last species has not so far been implicated in transmission to man there. Additional species of vectors and spirochaetes are maintained in the Rocky Mountain laboratory.

An account is given of the identification by xenodiagnosis of the spirochaetes isolated from two cases of infection contracted accidentally in the laboratory and three cases contracted outside, two in Washington and one in Idaho. Ticks of 2–4 species were fed on mice in which the strains had been established. At subsequent test-feedings, ticks of only one species transmitted each strain [*cf.* **31** 176–177]. The two Washington strains were transmitted by *O. hermsi* from Colorado but not by *O. parkeri* and the Idaho strain was transmitted by *O. hermsi* from Oregon but not by *O. parkeri* or *O. turicata*. The spirochaetes from the two laboratory cases were transmitted by *O. turicata* from New Mexico and were shown to belong to a strain of *B. turicatae* from Kansas. They were not transmitted by *O. parkeri* or *O. hermsi*, and transmission of one of them by the large form of *O. erraticus* from Morocco was also attempted without success. A further case of the transmission of the Kansas strain of *B. turicatae* by *O. turicata* from New Mexico is cited, as are also one of the transmission of *B. turicatae* from Texas by *O. turicata* from Kansas and one of a strain of spirochaetes from Idaho by *O. hermsi* from Idaho, California and Colorado. It is concluded that the experiments failed to produce any evidence of local specificity in the United States.

Lachmajer (J.), Wegner (Z.) & Kawecki (Z.). **Spontaneous-infection of Ticks *Ixodes ricinus* with the Virus of Tick Encephalitis in the Coast-district.**—*Bull. Inst. mar. Med. Gdańsk* **8** no. 3–4 pp. 173–182, 3 figs., 11 refs. Danzig, 1957. (With Summaries in Polish and Russian.)

Kawecki (Z.) & Wysoczyńska (H.). **Isolation of Strains of Tick Encephalitis from *Microtus arvalis* in the Szczecin District.**—*Op. cit.* **9** no. 1–2 pp. 5–10, 15 refs. 1958. (With Summaries in Polish and Russian.)

In the first paper, an account is given of the isolation of four additional strains of encephalitis virus [*cf. R.A.E.*, B **43** 10] from ticks (*Ixodes ricinus* (L.)) from two widely separated districts in the coastal zone of Poland. Two of the strains were isolated directly from the adults collected. The other two were isolated from larvae bred from engorged females taken on cattle. The larvae were fed on healthy mice, suspensions of the brains of mice that died were inoculated intracerebrally into other mice, and the strains maintained in serial passage. Nymphs developed from larvae from which one of the strains was isolated caused the death of mice on which they fed, sometimes with symptoms of paralysis. The strains from adults were highly virulent for mice from the first. Those from larvae had less effect initially, but their virulence increased on passage until it equalled that of the others. The strains were identified by means of complement-fixation and neutralisation tests and were found to resemble serologically a standard Russian strain of tick-borne encephalitis and to a smaller degree a Czechoslovakian strain. Little or no affinity was demonstrable with the virus of louping ill and none with that of western equine encephalitis or Theiler's mouse virus. All strains caused mortality in chick embryos.

The second paper comprises an account of the isolation in mice of five strains of virus from the brains of voles (*Microtus arvalis*) taken in the coastal zone in 1953. The strains were serologically similar to the Russian strain of tick-borne encephalitis, somewhat, though less, similar to the Czechoslovakian strain and a Scottish strain of louping ill, and quite distinct from Theiler's mouse virus. They were pathogenic for chick embryos when introduced into the chorioallantoic membrane and for white mice when inoculated intracerebrally and intraperitoneally, but not to guineapigs or white rats when inoculated intracerebrally or to rabbits when inoculated on a scarified cornea. This behaviour is typical of tick encephalitis.

Banfield (A. W. F.). **An Investigation of Ticks as Disease Vectors in Banff National Park, Alberta.**—*Canad. J. Zool.* **34** no. 5 pp. 417–423, 1 map, 4 refs. Ottawa, 1956.

Attempts to demonstrate the presence of *Rickettsia* (*Dermacentroxenus*) *rickettsi* in examples of *Dermacentor andersoni* Stiles collected in Banff National Park, Alberta, in several of the years since 1939 were unsuccessful until 1952, when a guineapig that was inoculated with a pool of 19 ticks and recovered after developing lesions and fever attributed to Rocky Mountain spotted fever was immune on challenge with a virulent laboratory strain. In 1953, a collection of 245 unfed ticks, comprising 238 adults of *D. andersoni* and seven of *D. albipictus* (Pack.) in 36 lots, was made between 20th April and 22nd June 1953 from 17 localities in the Park, and the adults of *D. andersoni* were examined for infection with *R. rickettsi* and other pathogens by W. L. Jellison and his colleagues at the Rocky Mountain laboratory in Montana. The tests included inoculation of mice as well as guineapigs, and the virus of Colorado tick fever was isolated from three of 20 pools. This was the first finding of the virus in Canada, but it has also been isolated from *D. andersoni* in Alberta by J. H. Brown [*R.A.E.*, B **45** 129]. None of the 19 guineapigs that served as hosts for the ticks and were inoculated with pools of them developed frank spotted fever in 20 days or were immune on challenge, and though one gave a significantly positive result in the complement-fixation test, Jellison did not consider this conclusive evidence of the presence of *R. rickettsi* in the Park. Two batches of ticks contributed to the pool in question, and four others to the pools from which the tick-fever virus was isolated, and all these batches were from areas frequented by bighorn sheep (*Ovis canadensis*), which appear to be the most important hosts of the adult ticks in the area. None of the 19 experimental animals showed any evidence of tularaemia, and one determination of Q fever [*Coxiella burneti*] was probably due to laboratory contamination.

Six Columbian ground squirrels (*Citellus columbianus*) collected for examination in May had nymphs of *D. andersoni* on them, but two chipmunks (*Eutamias minimus*) and one golden-mantled ground squirrel (*C. lateralis*) were not infested.

ANDERSON (R. C.). **The Life Cycle and seasonal Transmission of** *Ornithofilaria fallisensis* **Anderson, a Parasite of domestic and wild Ducks.**—*Canad. J. Zool.* **34** no. 5 pp. 485–525, 20 figs., 59 refs. Ottawa, 1956.

The following is virtually the author's abstract. White Pekin ducklings kept outdoors in Algonquin Park, Ontario, frequently become infected with *Ornithofilaria fallisensis*. Ducklings exposed during the Simuliid seasons in 1952–55 became infected. The microfilariae developed to the infective stage in *Simulium venustum* Say, *S. parnassum* Mall., *S. ruggylesi* Nicholson & Mickel, and various members of the subgenus *Eusimulium* identified as *S. euryadminiculum* Davies, *S. croxtoni* Nicholson & Mickel, and *S. latipes* (Mg.). Only the last four species were found feeding naturally on the ducks in 1955. The microfilariae did not develop significantly in several species of mosquitos or in *Culicoides* sp. Members of the subgenus *Eusimulium* were collected from ducks in 1955 only during the early part of the Simuliid season, whereas *S. rugglesi* was collected from 26th May to mid-July. Ducklings exposed when these ornithophilic Simuliids were active became infected, and a consideration of the times after exposure at which microfilariae appeared in their blood indicates that species of *Eusimulium* were the vectors in the first part of the fly season and that *S. rugglesi* was the sole vector thereafter.

The development of the microfilariae to the infective stage takes place in the haemocoele of the fly and requires 7–14 days, depending on the temperature. There are two moults during development and a " sausage-stage ". Microfilariae appeared in the blood of three parasite-free ducklings 30–36 days after third-stage larvae were injected into them; adult worms were recovered from one of these birds. The microfilariae exhibit a diurnal periodicity. The courses of the microfilaraemias of experimentally and naturally infected birds were compared. Re-exposure failed to alter the declining microfilaraemias of ducks or to result in a reappearance of microfilariae in ducks from the blood of which microfilariae had disappeared. Since parasite-free, adult ducks became infected during exposure, it is concluded that infected birds acquire an immunity to *O. fallisensis*. A few ducklings seemed to exhibit a natural resistance to infection. An adult of

O. fallisensis was found in a black duck (*Anas rubripes*) from Algonquin Park, and it is suggested that these birds are the reservoirs of infection there.

ZUMPT (F.). **A preliminary Survey of the Distribution and Host-specificity of Ticks (Ixodoidea) in the Bechuanaland Protectorate.**—*Bull. ent. Res.* **49** pt. 2 pp. 201–223, 4 maps, 23 refs. London, 1958.

Collection data are given for 21 species of ticks, one represented by two subspecies, recorded from the Bechuanaland Protectorate. The general distribution, hosts and medical and veterinary importance of each species are discussed. The shrub desert formations of the Kalahari are shown to be unsuitable habitats for most species of ticks; only a few can survive under severe desert conditions. *Ornithodoros moubata* (Murr.) is the vector of the spirochaete (*Borrelia duttoni*) of African relapsing fever, and is the most important tick in the Protectorate from the medical point of view. It was found in native huts in the eastern part as far north as Francistown and in Ngamiland and near Tsane. Its further distribution has not yet been established. Infection was found in one or more of a batch of 20 from Kanye. Relapsing fever in man has been recorded in several places, and occasional epidemics are to be expected wherever *O. moubata* is found. *Amblyomma hebraeum* Koch, *Haemaphysalis leachii leachii* (Aud.), *Rhipicephalus evertsi evertsi* Neum., *R. appendiculatus* Neum., *R. sanguineus sanguineus* (Latr.) and *Hyalomma truncatum* Koch and *H. rufipes* Koch are known to be able to harbour *Rickettsia conori*, which causes tick-bite fever in almost every European new-comer to the Protectorate.

Cattle in the eastern area and in Ngamiland were found to be infested by ten species of ticks, of which *A. hebraeum*, *H. rufipes*, *H. truncatum*, *Rhipicephalus appendiculatus*, *R. e. evertsi*, *R. simus simus* Koch. and *Boophilus decoloratus* (Koch) are the most important, both because of their numbers on cattle and because they probably transmit diseases of which they are vectors elsewhere. These diseases include four known to occur in the Protectorate, of which heartwater (*Cowdria ruminantium*) is transmitted by *A. hebraeum*, redwater (*Piroplasma* (*Babesia*) *bigeminum*) by *Boophilus decoloratus* and the three species of *Rhipicephalus*, European redwater (*P.* (*B.*) *bovis*) probably by *Boophilus decoloratus* and anaplasmosis (*Anaplasma marginale*) by *B. decoloratus* and *R. simus simus*. Dogs were mainly parasitised by *R. simus simus*, which was much more numerous on them than were *R. sanguineus sanguineus* and *H. l. leachii*.

HARLEY (J. M. B.). **The Availability of** *Glossina morsitans* **Westw. in Ankole, Uganda.**—*Bull. ent. Res.* **49** pt. 2 pp. 225–228, 6 refs. London, 1958.

The following is substantially the author's summary. The populations of *Glossina morsitans morsitans* Westw. in two areas in Ankole, Uganda [*cf.* *R.A.E.*, B **44** 115], were studied by the release-recapture method to obtain estimates of its standard availability [**44** 116]. These estimates gave maximum and minimum fiducial limits of 2 and 0·19 per cent. The values are considerably lower than the estimates, obtained by Jackson in Tanganyika, of about 10 per cent. [*cf.* also **42** 149]. The difference is of practical importance in that a single fly caught in Ankole indicates a much larger population than one caught in Tanganyika, and this is the probable explanation of the problem of trypanosomiasis of cattle round the edges of the fly-belt in Ankole, where routine catches yielded few flies.

Gillett (J. D.). **Laboratory Colonisation of the Mosquito,** *Eretmapodites chrysogaster* **Grah.**—*Bull. ent. Res.* **49** pt. 2 pp. 287–290, 7 refs. London, 1958.

The virus of Rift Valley fever was isolated six times from mixed lots of mosquitos caught in forest in Uganda in 1944 in circumstances that indicated that the most important belonged to the genus *Eretmapodites* [*cf. R.A.E.*, B **34** 159]. Species of the group of *E. chrysogaster* Grah. were more numerous than any others of the genus, and members of this group were later used in the successful laboratory transmission of the virus of Rift Valley fever from mouse to mouse or lamb, and from lamb to lamb or mouse. In view of the possible importance of this species-group in the epidemiology of Rift Valley fever and its ability to transmit the virus of yellow fever [**16** 236], laboratory colonisation of a member of it was attempted. The species chosen was *E. chrysogaster, sens. strict.*, and a colony was maintained successfully for over a year without any reinforcement. It was established from a batch of eggs laid by a female caught in nature near Entebbe in March 1953, and identified by examining the genitalia of male progeny. Females mated immediately after their first blood-meal but would not do so until they had at least started to feed. Feeding was usually on the arm of a human volunteer. Moist paper, moist cotton-wool and free water above paper or cotton-wool all proved unsatisfactory as egg-laying media in large cages, and, as larvae of the group are often found in nature in water in the fallen bracts of banana (*Musa* sp.), sterilised, water-filled banana bracts were provided. These proved completely satisfactory. Bracts bearing eggs were transferred to aluminium pots. The young larvae fed largely on the substance of the bract on which the eggs had been laid, and the bract also provided cover and so reduced cannibalism. Gradually increasing amounts of a mixture of powdered dog-biscuit and Bemax were added to the water daily to provide additional food. Little remained of the bract by the time the larvae reached the third instar.

van den Berghe (L.) & Lambrecht (F. L.). **Preliminary Note on the Biology of** *Glossina vanhoofi* **Henrard.**—*Bull. ent. Res.* **49** pt. 2 pp. 291–300, 1 pl., 1 fig., 6 refs. London, 1958.

Glossina vanhoofi Henrard [*R.A.E.*, B **42** 32] was found in the dense rain forest at Irangi in the Belgian Congo in 1955. It does not normally attack man and appeared to be scarce until a more thorough search in October showed that it could be found resting on small saplings, head downwards, at an average height of about 4–5 ft. In a survey of such resting places lasting three months (December–February) on a fly-round transecting three valleys and two hill-tops, the resting density (number of resting flies observed per 10,000 metres) averaged 35 but was found to be correlated with the profile of the transect, the hill-tops yielding more flies than the valleys. The fly-round was worked three times a day. Density was highest during early morning in all three months. There was little difference between midday and evening densities in January and February, but the evening density was the lower in December. The resting height varied in much the same way in all the sections of the fly-round, being nearer the forest floor later in the day than in the early morning. The average height remained virtually constant during the three months. Females rested somewhat lower than males. The sex ratio was about 1 : 1 and was very constant throughout the day and the period of the observations.

All the flies found resting were in an advanced stage of hunger, but seemed to be quite unconscious of movement in their vicinity. It is possible, however, that the species finds its hosts by smell, as examples were caught in a monkey-baited mosquito trap in the forest and seven were taken in 15 minutes by a fly-boy who stopped on the road to repair his bicycle when he was hot and perspiring. Puparia were found in "classical" sites, but the proportion containing living pupae was small. Adults in captivity fed readily on a porcupine (*Atherurus africanus*). A number of larvae were deposited and pupated normally, the adults emerging after about 35 days at 26°C. [78·8°F.] and 90 per cent. relative humidity.

Nielsen (E. T.). **The initial Stage of Migration in Salt-marsh Mosquitos.**—*Bull. ent. Res.* **49** pt. 2 pp. 305–313, 2 pls., 1 fig., 10 refs. London, 1958.

The following is virtually the author's summary. The departure of the newly emerged adults of *Aëdes taeniorhynchus* (Wied.) from the breeding sites [*cf. R.A.E.*, B **43** 63] was studied in Florida in 1951–53. The departures, which are presumed to be the initial stage of the migratory flight, were observed to take place only in the dark period of the 24 hours, and as the vast majority of individuals were ready to take off at dusk, spontaneous mass departure took place at that time. Samples of the resting population were taken at intervals before and after the mass departure, and departing migrants were also caught. The average age of the males in each sample was estimated by the proportion in different stages of hypopygial rotation. It is concluded that migratory activity begins when the insects are six or more hours old. The end of the migratory period is not yet known. In all of 21 departing females examined, the ovaries were immature and the spermathecae empty.

Barlow (F.) & Hadaway (A. B.). **Studies on aqueous Suspensions of Insecticides. Part VI. Further Notes on the Sorption of Insecticides by Soils.**—*Bull. ent. Res.* **49** pt. 2 pp. 315–331, 8 refs. London, 1958. **Part VII. The Influence of Relative Humidity upon the Sorption of Insecticides by Soils.**—*T. c.* pp. 333–354, 6 graphs, 7 refs.

The following are substantially the authors' summaries of these two papers, which belong to a series [*cf. R.A.E.*, B **44** 3 etc.].

Quantitative measurements of the sorption of γ BHC and dieldrin in Uganda mud blocks showed that γ BHC diffused more rapidly than dieldrin and achieved an almost uniform concentration throughout the sprayed blocks within a few weeks. Only when the uniform concentration had been reached did loss by evaporation from the blocks become marked. Increased dosages of γ BHC gave roughly proportional increases in biological activity. Sorption greatly prolonged the persistence of γ BHC on the blocks, as compared with that of similar deposits on glass. Dieldrin behaved in the same way as γ BHC, although, because of its slower rate of diffusion, the distribution in the blocks took 48 weeks to reach the stage reached by γ BHC in eight. There was no appreciable loss of dieldrin during this time, whereas about 90 per cent. of the deposit on glass plates had been lost. Dieldrin, γ BHC and DDT were recovered from the adsorbed state on mud and identified. Any decomposition is therefore likely to be negligible. Dieldrin was also recovered from two soils that had much higher "surface-acidities" than the standard. Active mud can sorb from an evaporating deposit only the portion of insecticide vapour that happens to diffuse in its direction. This is to be expected, but the system has some peculiarities because evaporation of γ BHC from filter papers was much more rapid when they were over mud blocks than when they were not. Measurements of the distribution of DDT and dieldrin in soils less active than the standard

Uganda one showed that both the initial adsorption and subsequent diffusion were very much slower. The activity of Uganda soil was not reduced by removal of material soluble in organic solvents, and was only partly reduced by complete extraction of iron compounds. Variation in temperature over the range 20–30°C. [68–86°F.] had only small effects on the diffusion of DDT and dieldrin within mud blocks. Repeated applications of DDT and dieldrin to the same blocks did not result in any observable slowing in the rate of disappearance of the surface deposit; they merely increased the concentration of insecticide in the successive layers of the mud.

Changes in relative humidity had a very marked influence on the biological activities of γ BHC, dieldrin and DDT sorbed on Uganda mud blocks. In agreement with field observations [*cf.* **45** 188], kills of mosquitos increased as the humidity increased and this effect was rapidly reversible. The rate of disappearance of insecticide particles from the mud surface increased with decreased humidity, but the rates of diffusion of sorbed insecticide away from the surface were greater at higher humidities. It is suggested, therefore, that when the biological activity of a mud surface is increased by an increase in humidity, the insects acquire a greater dose of insecticide not because the concentration of insecticide in the surface layer is greater but because the insecticide acquires a greater mobility. This greater mobility results in a more rapid diffusion in the mud itself, away from the treated surface, and a greater potential for diffusion into insects resting on the surface. Support for these conclusions was obtained by showing that the change in biological activity of dieldrin-treated mud blocks transferred from low to high humidity occurred at about the same rate as the increase in water content of the blocks. The influence of humidity on the sorption of DDT and dieldrin on a selection of soil samples of widely differing origin was observed. Both insecticides disappeared from the surface more rapidly at low than at high humidity on all the soils.

Crisp (G.). **An ephemeral Fauna of Torrents in the Northern Territories of the Gold Coast, with special Reference to the Enemies of** *Simulium*. —*Ann. trop. Med. Parasit.* **50** no. 3 pp. 260–267, 12 refs. Liverpool, 1956.

In the course of investigations on *Simulium damnosum* Theo. in the Northern Territories of the Gold Coast [*R.A.E.*, B **45** 191–192], a brief survey was made of the fauna of two short stretches of torrent, one in the Red Volta and the other in the Nasia, in both of which it was breeding with one or two other species of *Simulium*. The forms found are grouped into those that prey on the larvae of *Simulium*, those that possibly destroy or disturb the eggs or larvae, those that do not, and those (chiefly dragonflies) that prey on the adults. Notes are given on their prevalence and seasonal abundance. The most important predators in the Red Volta appeared to be the nymphs of *Neoperla spio* (Newm.), but this Perlid was not found in the Nasia. The larvae of Trichoptera of the genus *Chimarra* occurred in both rivers and attacked the Simuliid larvae in large numbers. Fish are also important predators.

Duke (B. O. L.), Crewe (W.) & Beesley (W. N.). **The Relationship between the Size of the Blood-meal taken in by** *Chrysops silacea*, **the Development of the Fly's Ovaries, and the Development of the Microfilariae of** *Loa loa* **taken in with the Blood-meal.**—*Ann. trop. Med. Parasit.* **50** no. 3 pp. 283–290, 2 figs., 8 refs. Liverpool, 1956.

Tabanids need a blood-meal for the development of each batch of eggs, and females of *Chrysops silacea* Aust. taken while attacking man usually have undeveloped ovaries, though a few mature eggs from a previous oviposition may be present. Kershaw and others, in work to be published, have shown that larvae of *Loa loa* in attacking females are usually in the fifth or tenth day of development. This suggests a feeding and oviposition cycle of five days, and complete development of the ovaries and subsequent oviposition do not take place in less than six days in the laboratory. However, some females that come to bite with undeveloped ovaries harbour developing *Loa* larvae that are only two or three days old. This suggests that the flies have taken a blood-meal without consequent development of the ovaries, possibly because the meal was too small. Females of *C. silacea* attack persistently in an attempt to obtain a blood-meal, but may be prevented from feeding to repletion by conscious or unconscious disturbance by the host. Experiments were therefore undertaken to determine whether a female can ingest a blood-meal too small for subsequent development of the ovaries, whether microfilariae of *L. loa* develop after ingestion in such a meal, and whether the development of the ovaries after a partial blood-meal influences the proportion of ingested microfilariae that develop.

Flies were taken attacking man in the forest near Kumba, in the British Cameroons, kept overnight and allowed to feed for different lengths of time on volunteers with or without microfilariae of *L. loa* in their peripheral blood. The size of the meal was ascertained by weighing the flies before and after it; experiments [*R.A.E.*, B **43** 73] had shown that it is 25–55 mg. in a fly that feeds to repletion, with a mean of about 40 mg. Of 105 females examined 5–7 days after taking partial blood-meals from infected volunteers, 40, 62 and three had undeveloped, fully developed and partly developed ovaries. In 48 examined 4–6 days after feeding on uninfected volunteers, the corresponding figures were 16, 27 and five. Normal development of the ovaries occurred in some of the flies that ingested 3·6–14·2 mg. blood, in all of those that ingested more, and in none of those that ingested less. The ingestion of microfilariae with partial blood-meals did not influence the amount of blood needed to initiate development of the ovaries, and the development of the ovaries did not influence the proportion of ingested microfilariae that succeeded in developing. This probably accounts for the finding in nature of flies that have undeveloped ovaries and show no trace of a previous blood-meal and yet harbour large numbers of *Loa* larvae at the second- or third-day stage of development. The smallness of the blood-meals that resulted in development of the ovaries in the experiments suggests that a fly interrupted at an early stage in its feeding in nature might ingest enough blood to cause it to seek a resting place and refrain from attempting to feed further until its ovaries had matured and it had oviposited. This is supported by the fact that very few of the flies taken with hand-nets while attacking man show any fresh blood in the gut.

LEWIS (D. J.). **The medical Entomology of the Tonkolili Valley, Sierra Leone.**—*Ann. trop. Med. Parasit.* **50** no. 3 pp. 299–313, 1 map, 38 refs. Liverpool, 1956.

The results are given of a survey for the insects likely to be of medical importance in the Tonkolili valley in Sierra Leone, made between September and December 1955 because of the projected development of the valley for iron mining. The topography, climate and vegetation of the area, which at the time was rural, with no roads, are briefly described, and lists, arranged by orders and families, are given of the numerous species found, with notes on circumstances of capture and prevalence of many of them. The principal insect-borne diseases found in a medical survey of the valley were malaria and onchocercosis [caused by *Onchocerca volvulus*]; the latter occurred in about 85 per cent. of the indigenous adults, but there was little blindness.

Simuliids were represented by eight species of *Simulium* and were not very abundant, possibly because the streams receive little sunlight and the Tonkolili is not very large. *S. damnosum* Theo. is the only Simuliid that attacks man in the valley, and the *Onchocerca* rate in it was only 10 per cent. The rate in females caught biting was higher in the morning than in the afternoon, as the afternoon catches included a higher proportion of nulliparae. The physiological age of the females could be recognised by the appearance of the ovary and oviducts, but not by the peritrophic membrane, as this was found to develop round the meconium in the young fly as well as round the blood-meal later.

There were ten species of *Anopheles*, but only *A. marshallii* (Theo.), *A. hancocki* Edw. and *A. gambiae* Giles were common. The torrential rains and hilly terrain, the presence of ferruginous material in the swamps, and the abundance of Cyprinodontid fish are believed to account for the smallness of the numbers of mosquitos. *A. gambiae* was not generally abundant, and its presence is attributed to human activity. Both *A. hancocki* and *A. marshallii* are exophilous, and many females were found biting out of doors at dawn. Dissections revealed sporozoites in one of 115 females of *A. hancocki* and two of 17 of *A. gambiae* in a village in which the incidence of malaria was high, and developing filariae, probably *Wuchereria bancrofti*, in two of 20 of *A. gambiae* in another village. Sporangia of a fungus, apparently identical with the species of *Coelomomyces* referred to by Walker [*R.A.E.*, B **27** 65] as type 2 [*cf.* also **43** 69] were seen in the ovaries of many females of *A. hancocki*. The prevalence of this infection and the fact that only a few small breeding places of *A. hancocki* were found makes the abundance of the adults surprising. A few of the 42 species of mosquitos of genera other than *Anopheles* bite man in small numbers. The common species breed in tree-holes, plant axils and fallen leaves. An outbreak of yellow fever occurred some 40 miles to the north of the survey area in 1950 and monkeys are present in the Tonkolili forests, but there is thought to be little risk of an epidemic in the villages, because *Aëdes aegypti* (L.) and *A. africanus* (Theo.), the only potential vectors observed to bite man locally, are not numerous at ground level.

Other blood-sucking Diptera found included *Glossina fusca* (Wlk.) and *G. palpalis* subsp. *gambiensis* Vanderplank, which were very scarce, and Tabanids, among which were no species of *Chrysops* or *Haematopota*.

GORDON (R. M.) & WILLETT (K. C.). **A preliminary Account of the Deposition by the Tsetse-fly of the infective Forms of** *Trypanosoma rhodesiense*, **their subsequent Migration to the general Circulation, and their Development to the Blood Forms.**—*Ann. trop. Med. Parasit.* **50** no. 3 pp. 314–318, 4 refs. Liverpool, 1956.

With the aid of an adaptation of an apparatus previously used for studying the feeding habits of mosquitos [*R.A.E.*, B **42** 129], the authors observed and made photographs of the process by which adults of *Glossina morsitans* Westw. obtain blood-meals from mammalian hosts. It was found that the labium, which is flexible, probes the host's tissues at different depths and in different planes, and that the fly feeds from one or more of the haemorrhages caused by a previous laceration of the capillaries [*cf.* **40** 9]. The taking up of blood is adjusted to the rate of flow, so that a pool is not usually formed until suction ceases. Saliva is ejected both during the probing and during feeding. It seems therefore that metacyclic trypanosomes in the saliva of a feeding tsetse will be widely distributed in the host's tissues and that some, and probably most, of them will be deposited near the torn capillaries.

The migration of the metacyclic forms of *Trypanosoma rhodesiense* following their deposition in the host was studied by marking the site at which a guineapig had been bitten by a heavily infected fly, killing the animal after an interval varying from 5 minutes to 24 hours, injecting some of its heart blood into a white rat and excising the tissues at the site of the bite down to and including the first muscle layer for histological examination, preparation of films and injection into rats. Metacyclic forms were also cultured for study of the life-cycle. It was concluded that the early life-cycle of *T. rhodesiense* in the guineapig is represented by a straightforward development of the deposited metacyclic forms into the blood forms, and that, once the parasite has received the stimulus caused by its transfer to the vertebrate host, migration to the general circulation and transformation to the blood forms occur with great rapidity, probably in less than 24 hours.

FAIRBAIRN (H.) & WILLIAMSON (J.). **The Composition of Tsetse-fly Saliva. I. A histochemical Analysis.**—*Ann. trop. Med. Parasit.* **50** no. 3 pp. 322–333, 1 pl., 20 refs. Liverpool, 1956.

WILLIAMSON (J.). **II. Analysis of Amino Acids and Sugars by Paper Partition Chromatography.**—*T. c.* pp. 334–344, 4 figs., 31 refs.

The following are the authors' summaries.

An analysis of the saliva of *Glossina palpalis* (R.-D.) was made by histochemical methods. From a large number of tests, positive reactions were found for the presence of the following substances only: protein or mucoprotein (containing a neutral mucopolysaccharide moiety), or both, glycolipid (containing unsaturated bonds) and ionised calcium. The loss of Giemsa staining of the saliva, which occurs in tsetse flies heavily infected with the polymorphic trypanosomes, is paralleled by the disappearance of positive reactions for all the above substances. These findings are discussed in relation to the metabolism of the metacyclic forms and to the nature of the salivary anticoagulant.

Paper partition chromatography was used for the amino-acid and sugar analysis of free and acid-hydrolysed samples of the saliva of *G. palpalis*. The following substances were demonstrated as present: β-alanine, arginine, asparagine, aspartic acid, cysteic acid, cystine, glutamic acid, glycine, histidine, iso-leucine, methionine, serine, taurine, threonine, tryosine, valine, inositol, and possibly arabinose.

BUDDEN (F. H.). **The Epidemiology of Onchocerciasis in Northern Nigeria.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 4 pp. 366–378, 2 figs., 18 refs. London, 1956.

Onchocercosis, caused by *Onchocerca volvulus*, was first reported in Northern Nigeria in 1908, but ocular onchocercosis was not recorded until 1952, although it was then an important cause of blindness in many parts of the region. The results are given of an investigation made in 1951–54, during which it was found that onchocercosis was endemic in each of the 12 provinces, and blindness caused by it was widespread. The distribution of heavily, moderately and lightly infected areas is recorded, and the relationship between the incidence of infection, reduced vision and blindness on the one hand, and age and sex on the other, and between the incidence of the infection and low population density are discussed. The distribution of onchocercosis is closely related to that of *Simulium damnosum* Theo. [*cf.* next abstract], but no obvious correlation has been found between the biting rate of *S. damnosum* and the amount and intensity of infection in the human population.

Crosskey (R. W.). **The Distribution of** *Simulium damnosum* **Theobald in Northern Nigeria.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 4 pp. 379–392, 6 maps, 8 refs. London, 1956.

The distribution of *Simulium damnosum* Theo. in Northern Nigeria, as determined in a survey made in 1952–55, is given province by province, shown on maps and discussed in relation to environmental factors. Areas in which the fly was not found and is believed not to occur are indicated. Its distribution is sporadic, extends over about a third of Northern Nigeria, and was found to depend primarily on geology, which determines the presence or absence of perennial rivers suitable for its breeding. These are closely related with the area of pre-Cambrian rock. Only in a few areas is the distribution more or less continuous over hundreds of square miles. Altitude, vegetation and climate appear to have less effect on distribution, except that the prolonged dry season and hot desiccating conditions may prevent the fly from establishing itself in the far north, largely by drying up the rivers [*cf.* *R.A.E.*, B **45** 19]. However, its absence north of latitude 12°18′N. is more certainly attributable to the absence of suitable breeding grounds. Most of the foci of *S. damnosum* occur where the density of the human population is low (0–60 per sq. mile), some where it is moderate (60–150) and hardly any in the areas of dense population, most of which are in the far north. Onchocercosis caused by *Onchocerca volvulus*, which *S. damnosum* transmits, is therefore almost entirely a rural problem. With one exception, it was found in all foci of the fly in which it was sought, even the scattered ones furthest north in arid areas [*cf.* **41** 39]. The exception was an artificial focus at Pega in the north where boulders had been laid in the river bed to make a crossing for motor vehicles.

It is stated in a footnote that *S. bovis* De Meillon bites man avidly in certain localised areas of Northern Nigeria [*cf.* **44** 137], and is suspected of acting as a subsidiary vector of *O. volvulus* in parts of Abuja Emirate (Niger Province) where *S. damnosum* also occurs. F. H. Budden has reported a standardised onchocercosis rate of 759 inhabitants per 1,000 over ten years old in a village in which there are only small numbers of *S. damnosum* but large numbers of *S. bovis* with biting rates up to 222 per boy-hour. Furthermore, dissections of *S. bovis* have shown the presence in the thorax of worms morphologically indistinguishable from *O. volvulus*.

Heisch (R. B.), Goiny (H. H.) & Ikata (M.). **A new Vector of Filariasis in East Africa.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 4 pp. 421–422. London, 1956.

In the course of dissection of mosquitos from houses and bush on the Island of Patta off the Kenya coast, where the incidence of filariasis caused by *Wuchereria bancrofti* is high, filariae were found in 14, 7 and 6 per cent. of females of *Culex pipiens fatigans* Wied., *Aëdes aegypti* (L.) and *A. pembaensis* (Theo.) from houses, and in 6·3 per cent. of females of *A. pembaensis* coming to human bait in the bush. *A. pembaensis* was the predominant mosquito, and five out of 34 positive females of this species showed proboscis infections. No proboscis infections were found in the other species. This suggests that *A. pembaensis* is an important local vector of *W. bancrofti*, though all the infections may not have been of human origin. If it is a vector in East Africa, it may be a dangerous one, as it attacks man in the bush as well as in houses.

Dissanaike (A. S.), Dissanaike (G. A.) & Niles (W. J.). **Infective filarial Larvae tagged with Phosphorus-32.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 4 p. 425. London, 1956.

Radioactive infective larvae of *Wuchereria bancrofti* were obtained by rearing second- and third-instar larvae of *Culex pipiens fatigans* Wied. in water containing ^{32}P, feeding the resulting females, about three days after emergence, on patients with high microfilarial counts, and dissecting them after 12 days. The mean activities of females from larvae reared in water containing 0·1 and 1 μc. ^{32}P per ml. were 107 and 710 mμc., respectively, 3–5 days after emergence, but only the females from larvae reared in the lower concentration took a blood-meal. Their radioactivity was measured 12 days later and they were then dissected. The infective filarial larvae from them were washed in batches to eliminate contamination from surrounding body fluids and then dried, after which their radioactivity was found to be consistent at about 22 β-counts per minute per larva for all the batches studied. Infective larvae from normal mosquitos fed on the same patients had negligible radioactivity after they had been immersed alive in the body fluids of radioactive mosquitos for about half an hour and then subjected to the same process of washing. This indicates that the observed activities of the larvae from the radioactive mosquitos were not due to surface contamination.

Gray (H. F.). **The confusing Epidemiology of Malaria in California.**—*Amer. J. trop. Med. Hyg.* **5** no. 3 pp. 411–418, 7 refs. Baltimore, Md., 1956.

Malaria was present in the great central valley of California for some hundred years prior to its almost complete disappearance about 1930, and, at least since 1910, it has been supposed that *Anopheles freeborni* Aitken was the only important vector there. The few epidemics since 1930 have been small and local, but mosquito catches at a girls' camp where one occurred in 1952 [*R.A.E.*, B **44** 26] showed that *A. freeborni* was less plentiful than *A. punctipennis* (Say). The fact that *A. punctipennis*, unlike *A. freeborni*, seldom enters houses, does not make it a less likely vector in an area of warm climate where people sit out of doors in the evenings and sometimes sleep in the open, but indicates on the other hand that the girls in the camp were probably more likely to have been bitten by it. The same is true of an encamped migratory population among whom an outbreak occurred in 1934 in an area in which *A. punctipennis* was the dominant species. This led the author to re-examine the epidemiology of malaria in California, and he reviews his findings and discusses the likely effect on both species of *Anopheles* of certain changes that have taken place in the past 100 years.

An epidemic that caused very high mortality among the Indians of the valley in 1833 was almost certainly due to recently introduced malaria transmitted by a vector that feeds in the open, and the miners of the gold-rush period, among whom malaria was severe, worked in the lower courses of small rivers in foothill areas, where *A. punctipennis* is more prevalent than *A. freeborni*, and lived in tents or cabins in the open where they would be exposed to attack by it. The picture is much less clear on the floor of the valley away from streams, particularly after the introduction of irrigation at the turn of the century. Malaria was prevalent when seepage from unlined canals favoured *A. freeborni* in sunny situations, and decreased when seepage was reduced by the lining of the canals. The cultivation of rice, however, which began about 1915 and still continues, is generally accompanied by very large numbers of *A. freeborni* but little malaria. This may be partly because few people live actually in the rice-field area or because, as R. E. Fontaine has observed, *A. freeborni* does not bite man in July and August, though it does so fiercely on its migratory flight in October and on warm days in January. *A. punctipennis* is practically absent from the rice areas.

It is concluded that much uncertainty remains as to which species of *Anopheles* has been the principal vector, but that *A. punctipennis* may be more important than it was thought to be and that in any future outbreak at least as much attention should be paid to its control as to that of *A. freeborni*.

de Rodaniche (E.). **Survey of Mosquitoes captured in Honduras for Yellow Fever Virus.**—*Amer. J. trop. Med. Hyg.* **5** no. 3 pp. 480–482, 3 refs. Baltimore, Md., 1956.

An epizootic of yellow fever among monkeys on the north coast of Honduras began in December 1953 and continued throughout the summer of 1954 [*R.A.E.*, B **45** 34], and 10,309 of the mosquitos collected in August and early September in the affected area and sent to Panama to be tested for the presence of the virus were received alive. They included 5,657 examples of the group of *Psorophora ferox* (Humboldt), which comprised *P. ferox*, *P. lutzii* (Theo.) and *P. varipes* (Coq.), 1,393 of *Trichoprosopon magnus* (Theo.), 918 of *Aëdes* (*Ochlerotatus*) spp., 710 of *Mansonia* spp. and 498 of *Haemagogus equinus* (Theo.), and nearly all were from a place where a dead monkey with pathological changes characteristic of yellow fever was found on 6th August. They were divided into batches of 50 or less (each belonging to one of 15 species or species groups) and suspensions of the various batches were tested by intercerebral injection into white mice and also by subcutaneous inoculation into rhesus monkeys (*Macaca mulatta*) in the case of the suspensions of *H. equinus*, *T. magnus*, *Aëdes* (*Ochlerotatus*) spp. and *Mansonia* spp., which seemed the most likely vectors on epidemiological grounds. No yellow-fever virus was recovered from any of the mosquitos; mice were not immune when challenged at the end of their observation period, and the monkeys did not develop neutralising antibodies in their blood. A neurotropic virus immunologically distinct from yellow fever was, however, isolated in mice from a batch of 50 mosquitos of the group of *P. ferox*.

Fletcher jr. (O. K.), Major (J.) & Cable (R.). **Studies on Fly Breeding in sanitary Pit Privies in south Georgia.**—*Amer. J. trop. Med. Hyg.* **5** no. 3 pp. 562–572, 3 figs., 22 refs. Baltimore, Md., 1956.

The knowledge that house-flies (*Musca domestica* L.) breed in and feed on human faeces and so might carry agents of intestinal diseases led to the development of the sanitary pit privy incorporating fly-proof construction, on the assumption that house-flies would breed and feed in such a privy unless prevented. As, however, fly-proofing adds considerably to the cost of pit privies, a study was undertaken in Georgia to determine to what extent house-flies feed and breed in them. The environment in the pit is quite different from those in which flies were found to breed in faeces by earlier investigators [*cf. R.A.E.*, B **6** 116], because it is deep and dark with the hole in the seat as the only opening, whereas in the others, the faecal matter is exposed to light and air. There was also the possibility that some records of *M. domestica* from faeces were due to misidentification. In 1943, P. C. Beaver reported observations in which he found *Musca* larvae in only two of 97 collections from sanitary pit privies.

In the first phase of the investigations, the numbers and kinds of insects entering and leaving the pits were ascertained by installing fly traps over the seat opening of 20 sanitary pit privies in various states of repair to trap flies leaving the pit, and inverting conical traps into the seat opening of ten other privies to catch insects trying to enter. Over 44,500 insects were caught in the 613 collections made in 1950–52. The great majority were Diptera, but only 137 were *M. domestica*, the others including 33,552 individuals of *Psychoda* spp., 5,472 of *Hermetia illucens* (L.), 1,384 of *Dendrophaonia hilariformis* (Stein) (an Anthomyiid that closely resembles *M. domestica*), 666 of *Ophyra leucostoma* (Wied.) and 852 of *Culex pipiens fatigans* Wied. (*C. quinquefasciatus*, auct.). *H. illucens* was present in virtually all the privies. *M. domestica* appeared in half the privies, but often only once and always in small numbers. In most of the privies that occasionally produced it, the pits were filled with faecal wastes to within a foot or two of the surface and contained also miscellaneous rubbish, so that they had assumed some of the characters of surface privies. House-flies are positively phototropic, and the illumination in different pits ranged from 0·01 to 1·58 foot-candles on bright sunshiny days and from 0 to 0·25 foot-candles on cloudy days.

About four million Dipterous larvae were collected from the pits for examination, but no larvae of *Musca* were found among them. *H. illucens* made up about 97 per cent. of the total. In view of these findings, known numbers of *Musca* eggs were introduced into selected pit privies to determine whether the species could develop in them. Only 355 adults resulted from over one million eggs. Another experiment, in which the larvae were reared in jars, showed that the presence of large numbers of larvae of *H. illucens* was not detrimental to the smaller larvae of *M. domestica*.

It is concluded that fly-proofing of properly constructed pit privies is unnecessary in Georgia.

SHAHGUDIAN (E. R.). **Notes on** *Anopheles marteri* **Senevet and Prunnelle, 1927.**—*Proc. R. ent. Soc. Lond.* (A) **31** pt. 4–6 pp. 71–75, 2 figs., 34 refs. London, 1956.

The following is based on the author's conclusions. Comparison of larvae of *Anopheles marteri* Sen. & Prun. from Algeria [*R.A.E.*, B **16** 189] with larvae of *A. marteri* var. *conquensis* Torres Cañamares from Spain [**36** 62] revealed no differences, and the original descriptions of adults of *conquensis* apply equally well to *A. marteri* from Algeria. It is therefore considered that *conquensis* is a synonym of *marteri*. Larvae of *A. marteri* from Algeria, Tunisia, Spain, Jordan and Israel were found to have shorter posterior clypeal hairs than those from Sardinia, Greece, Tadzhikistan and Persia, and it is proposed that the first group should be regarded as subsp. *marteri* and the second as subsp. *sogdianus* Keshish'yan [*cf.* **27** 183; **36** 131]. These mosquitoes show no constant morphological differences in other stages.

Smith (A.). **Notes on Microclimate at the Sites of Breeding and Biting of *Aëdes* Species (Diptera: Culicidae) on Ukara Island, Tanganyika.**—*Proc. R. ent. Soc. Lond.* (A) **31** pt. 4–6 pp. 81–85, 1 ref. London, 1956.

The following is largely based on the author's summary of observations made on Ukara Island in Lake Victoria. Reflected light from a rock pool containing larvae of *Aëdes vittatus* (Big.) was of the order of 60 foot-candles as compared with 2 foot-candles during the brightest parts of the day above a pool in a rot hole in a mango tree containing larvae of *A. africanus* (Theo.), *A. aegypti* (L.) and *A. apicoargenteus* (Theo.). Temperature varied by 4·5°C. [8·1°F.] in the rock pool, 1°C. [1·8°F.] in the rot hole in the mango tree, and 2°C. [3·6°F.] in a rot hole in a pollarded tree containing larvae of *A. africanus* and *A. apicoargenteus*. The temperature of the water in the rock pool rose 5°C. [9°F.] above that of the air during the hottest part of the day, whereas the temperature of the rot holes was nearly 1°C. below that of the air.

More *Aëdes* adults were caught on human bait near foliage among which the light intensity was 2 foot-candles than near foliage among which it was 20 foot-candles. The biting activities of *Aëdes* spp. were studied in different natural surroundings on one day in May 1952. It was concluded that any effect of differences of temperature, humidity or light at a catching site was masked during daylight hours by the presence nearby of suitable thicket, which provides a resting place for females ready to attack man close by.

Rahm (U.). **Zum Problem der Attraktion von Stechmücken durch den Menschen.** [On the Problem of Attraction of Mosquitos to Man.]—*Acta trop.* **13** no. 4 pp. 319–344, 17 figs., 36 refs. Basle, 1956. (With Summaries in English and French.)

The following is largely based on the author's summary. A technique is described by which the attractiveness of the hand and arm for *Aëdes aegypti* (L.) can be compared, without their being bitten. It was used in experiments with five men and five women, all of white race, and also a jar filled with water at 43°C. [109·4°F.] and wrapped in a dry cloth to represent the lower arm or in a wet cloth to represent the hand. It was found that the hands of all the test subjects were much more attractive to the mosquitos than their arms. All-day tests showed that the mosquitos were active throughout the day. Individual tests resolved the ten people into three groups on the basis of the attractiveness of the hand. The most and least attractive groups both comprised one man and two women, but comparison of the attractiveness of their arms gave different results, and, in paired tests between the arms or hands of men and women of the same or different groups, men were definitely the more attractive. The attractiveness of the jar was intermediate between those of people of low and medium attractiveness.

The hand was generally a little warmer than the arm and gave off much more moisture. Moistening the arm increased its attractiveness, but attractiveness did not entirely correspond with humidity and temperature. Its decrease when the distance between the object and the mosquitos was increased was especially marked in the case of the jar, and it is probable that volatile substances exuded by the skin may play a part and may explain differences in attractiveness between individuals. Investigation showed, however, that carbon dioxide emitted by the skin does not determine attractiveness [*cf. R.A.E.*, B **45** 110].

JONES (J. C.). **A simple Method for sexing living** *Anopheles* **Larvae (Diptera, Culicidae).**—*Ann. ent. Soc. Amer.* **50** no. 1 pp. 104–106, 2 figs., 2 refs. Washington, D.C., 1957.

Examination of third-instar larvae of *Anopheles quadrimaculatus* Say showed that over 90 per cent. of heavily pigmented larvae were females and 70–100 per cent. of very light ones were males. Larvae of intermediate pigmentation, which were the most numerous, might be of either sex. The sex of living fourth-instar larvae could be determined with complete accuracy for 2–3 days after the moult by examination of the imaginal antennal disks within the head capsule. These disks are larger and more fully differentiated in males than in females of the same age. With experience, it was possible to determine the sex of 2–3 fourth-instar larvae in a minute. In recently moulted fourth-instar larvae, it was also possible to determine sex by examination of the reproductive organs. Both the gonads and the disks of the external genitalia are visible in males and not in females at this time, but they become obscured in one day. The morphology and the early development of the antennal disks are described. The sex of larvae in the first two instars could not be determined.

JEFFERY (G. M.). **Blood Meal Volume in** *Anopheles quadrimaculatus, A. albimanus* **and** *Aedes aegypti.*—*Exp. Parasit.* **5** no. 4 pp. 371–375, 8 refs. New York, N. Y., 1956.

The volumes of blood ingested in one complete blood-meal on man by females of *Anopheles quadrimaculatus* Say, strains of *A. albimanus* Wied. from Panama and from the Florida Keys, and *Aëdes aegypti* (L.) were found to average 3·3, 2·44, 2·46 and 2·62 cu. mm., respectively. The meals taken by females of *A. albimanus* were about twice the weight of the mosquitos themselves, whereas those taken by females of *A. quadrimaculatus* were only about 1·5 times the weight of the mosquitos. Differences in the susceptibilities of the two species or strains of *Anopheles* to infection with a given strain of a malaria parasite depend on several factors, but allowance for differences in the size of the blood-meal may increase the significance of the other factors when the species taking the larger meal is the less susceptible [*cf. R.A.E.*, B **41** 131] and decrease it when this species is the more susceptible [*cf.* **43** 201].

BRUIJNING (C. F. A.). **Notes on the common Species of** *Culicoides* (**Diptera: Ceratopogonidae**) **from Surinam in Relation to** *ozzardi*-**Filariasis.**—*Docum. Med. geogr. trop.* **9** no. 2 pp. 169–172, 19 refs. Amsterdam, 1957.

The literature on the relation of Ceratopogonids of the genus *Culicoides* to filariae, including Buckley's demonstration of the development of *Mansonella ozzardi* in *C. furens* (Poey) [*R.A.E.*, B **22** 251–252], is reviewed, and collection data are given for three species of the genus found by the author in Dutch Guiana, with records of their distribution elsewhere. *C. guttatus* (Coq.) was the most prevalent species, though it was rare in the forests of the interior. It was very common in the savannah areas and filariasis caused by *M. ozzardi* is almost wholly confined to the Amerindians who live in the sand savannahs or in the sandy area along the rivers. Filarial larvae, partly emerged from the proboscis, were seen in two specimens of *C. guttatus* that had been collected in the village of Matta, many inhabitants of which had microfilariae of *M. ozzardi* in their blood, and it is highly probable that it is the vector. The disease does not occur among other ethnic groups or in the population of the coastal area, and its failure to spread to them may be due to the limited flight range of *C. guttatus* and the isolation of Amerindian villages. *C. paraensis* (Goeldi) and *C. debilipalpis* Lutz were taken only in river villages in the forests of the interior. *C. paraensis* was the predominant species there, but no natural infections were found in it.

ALLAN (R. M.). **A Study of the Populations of the Rabbit Flea** *Spilopsyllus cuniculi* (**Dale**) **on the wild Rabbit** *Oryctolagus cuniculus* **in north-east Scotland.**—*Proc. R. ent. Soc. Lond.* (A) **31** pt. 10–12 pp. 145–152, 5 graphs, 4 refs. London, 1956.

The results are given of 15 months' observations on populations of *Spilopsyllus cuniculi* (Dale) on wild rabbits in north-eastern Scotland; they were made from 24th December 1953 to 4th March 1955 and could not be continued longer because the introduction of myxomatosis, of which this flea is a vector [*cf. R.A.E.*, B **45** 166–168], had made the rabbits too scarce. Once a fortnight, 20 fully grown trapped rabbits were examined to determine the total numbers and distribution of fleas on them. The area included farmland, rough pasture and woodland, but most of the rabbits were trapped on land covered with heather and bracken. The mean number of fleas per rabbit increased gradually until 5th February 1954 and very sharply in March. The increase in population occurred mainly on does in March, but the sexes were equally infested by 30th April, when there were 150·5 fleas per rabbit. Numbers then fell to a low level and remained low, with very little fluctuation from May until the end of October, after which there was a fluctuating rise until late February, when the population was again concentrated on the does. The trends for the first few months of 1955 corresponded remarkably with those for the same months of 1954, but populations were higher. This may have been due to very favourable breeding conditions for the flea in 1954, possibly aided by the destruction of large numbers of rabbits. Most rabbits carried 1–25 fleas, and very few had more than 225 at any time of the year. The graph for male fleas was similar to the one for all fleas. Males formed about 45 per cent. of the population, and there was no evidence that they died off more quickly than females. Gravid female fleas were found only in April, May and early June. Nearly 80 per cent. of the fleas were on the ears of the rabbits, and virtually all were concentrated there at some times of the year. Fleas were found on the head in considerable numbers in February, June and August–September, and on the body in January.

Fleas kept unfed in a refrigerator at 20°F. were alive after nine months and became quite active when exposed to warmer temperatures. Some were kept alive for 70 days in a vacated rabbit warren without food and for longer on rabbits in an outside run. A wild rabbit caught in April 1955 with abundant fleas on its ears died in captivity during the summer and a domestic rabbit was immediately put in the run. The fleas attached themselves to the new host, and nine could still be found on it at the end of January 1956.

A tentative life-history is suggested [*cf.* **45** 168] on the basis of these observations. The female fleas become gravid after a period of feeding and probably oviposit indiscriminately. Larvae hatch from the eggs that happen to be deposited in the nest of the rabbit and pupate, after an unknown period, in the doe's stop. A pregnant doe enters the stop early in the following year in search of a place to rear its young and becomes infested with fleas that have either hibernated in the nest as adults or have been stimulated to emerge from the pupae by the warmth or disturbance caused by its presence. These fleas occur on its body at first but then migrate to the head and settle on the ears.

Kettle (D. S.). **Rainfall and larval Density of** *Culicoides impunctatus* **Goetghebuer (Diptera: Ceratopogonidae).**—*Proc. R. ent. Soc. Lond.* (A) **31** pt. 10–12 pp. 173–177, 1 graph, 6 refs. London, 1956.

Data collected in the course of regular observation of the larval population of *Culicoides impunctatus* Goetgh. on Soutra Hill, Midlothian [*cf. R.A.E.*, B **44** 198; **45** 128], are given to show that there is a close correlation between larval density in the autumn and rainfall during the preceding period of adult activity (May–September). The existence of sites suitable for oviposition and their maintenance in a condition enabling the larvae to survive depends on a rainfall high enough to keep the peat moist, and high humidity, which depends to some extent on summer rainfall, ensures that more females live long enough to mature eggs. It is likely that rainfall may cease to be the critical factor determining population density in very wet regions. The amounts of rainfall in the May–September period and of annual rainfall, and the ratios between them, are given for various regions of Scotland on the basis of data obtained in 1866–90.

Kettle (D. S.). **Preliminary Observations on Weather Conditions and the Activity of Biting Flies.**—*Proc. R. ent. Soc. Lond.* (A) **32** pt. 1–3 pp. 13–20, 4 graphs. London, 1957.

The following is virtually the author's summary. The results are presented of a 24-hour study of weather conditions and the biting and flying activities of *Haematopota pluvialis* (L.), *H. crassicornis* Wahlb. and *Culicoides impunctatus* Goetgh. on open moorland at Kinlochewe in Wester Ross, Scotland. There were indications that activity in *Haematopota* was associated with high light intensity and warmth and activity in *C. impunctatus* with low light intensity and calm conditions. The results are discussed in some detail.

Bursell (E.). **Spiracular Control of Water Loss in the Tsetse Fly.**—*Proc. R. ent. Soc. Lond.* (A) **32** pt. 1–3 pp. 21–29, 2 graphs, 12 refs. London, 1957.

The following is based on the author's summary. Experiments showed that the rate of water-loss in *Glossina morsitans* Westw. decreases in the course of desiccation, because depletion of water reserves causes a decrease in transpiration, brought about by spiracular control. Moreover, the rate of water-loss of flies of which the spiracles have been blocked or are kept open by exposure to carbon dioxide is a linear function of humidity, but the curve with normal flies is asymptotic, rates of loss in dry air being relatively low; and this departure from the rectilinear relation must be caused by spiracular control. Thus dryness of the insect and dryness of the air both increase the degree of closure of the spiracles.

Jamnback (H.) & Wall (W.). **Control of Salt Marsh** *Tabanus* **Larvae with Granulated Insecticides.**—*J. econ. Ent.* **50** no. 4 pp. 379–382, 1 map, 4 refs. Menasha, Wis., 1957.

Experiments on the control of larvae of *Tabanus* spp. in salt marshes with granular formulations of insecticide were made on Long Island, New York, in 1955 and 1956. In 1955, granules of Attaclay or Diluex impregnated with dieldrin, aldrin, chlordane, heptachlor or DDT were applied by hand to 60-ft. square plots in salt marshes having high and relatively uniform populations of *Tabanus* larvae. Granules were used because they readily penetrate the dense marsh vegetation. Results were evaluated by a method in which the larvae are brought to the surface of cleared areas by the use of a pyrethrum spray [see next abstract]. Dieldrin was applied at dosages of 0·09–2·5 lb. per acre and was the most effective of the insecticides tested [*cf.* *R.A.E.*, B **45** 116]. No larvae could be found in plots treated with the higher dosages (0·6 lb. or more) after ten days, or in any of the plots after 32 days, when control plots yielded 14·9 larvae per sq. yard. DDT was the least effective insecticide, giving poor control in 28 days at 2 lb. per acre. The addition of 5 per cent. urea as a stabiliser to granules of 30/40 mesh Attaclay with 2·5 per cent. dieldrin, which was tried in 1956, did not appear to influence effectiveness.

In May of the latter year, two areas of about 105 and 232 acres, respectively, were treated from a helicopter with granules of 30/40 mesh Attaclay containing 2·5 per cent. dieldrin and 5 per cent. urea applied at 0·3 lb. dieldrin per acre. The average numbers of *Tabanus* larvae found per square yard in July and August in 1954–55 and (in brackets) in 1956 were 8·4 (0·2) in the larger treated area, 15·5 (3·5) in the smaller one and 13·6 (12·2) in a control plot. In the smaller treated area, which consisted of an entire isolated salt marsh, the treatment resulted in a great reduction in numbers of adults of *Tabanus*, as estimated by catches with adhesive traps, and the beach, which had been rarely used during the Tabanid season in 1955, was used without annoyance throughout the summer of 1956. In the larger plot, which was contiguous with untreated marsh, adult *Tabanus* populations remained high. If the action of an application made in late May persists until September, most larvae hatching from eggs laid during the summer will be killed and the benefit may extend to the second season.

WALL (W.) & JAMNBACK (H.). **Sampling Methods used in estimating larval Populations of Salt Marsh Tabanids.**—*J. econ. Ent.* **50** no. 4 pp. 389–391, 6 refs. Menasha, Wis., 1957.

Two methods of estimating populations of Tabanid larvae in salt-marsh sod were compared on Long Island, New York, in 1954–56. The first was bringing the larvae to the surface of a cleared area at low tide by spraying it twice at an interval of five minutes with a 1:19 dilution of the New Jersey larvicide. This is a concentrate consisting of 66 per cent. kerosene or similar petroleum distillate, 0·07 per cent. pyrethrins, 0·5 per cent. sodium lauryl sulphate and 33·5 per cent. water [*cf.* *R.A.E.*, B **23** 205]. It was used at 1 U.S. gal. diluted emulsion per sq. yd. About 87 per cent. of the larvae coming to the surface in 60 minutes under its influence did so in the first 40 minutes. Limited tests indicated that 0·5 oz. 10 per cent. γ BHC (lindane) in 1 U.S. gal. water [*cf.* **45** 116] was about as effective as the New Jersey larvicide, and a suspension of a wettable powder of pyrethrum and sulfoxide [1,2-methylenedioxy-4-(2-(octylsulphinyl)propyl)benzene] somewhat more effective. The second method was cutting foot-square samples of sod and drying them in a Berlese funnel, so that larvae driven out in the drying process fell into a jar of marsh water. This water was examined every day or two days. The samples were 1½ ins. thick, as experiments in which plugs 8½ ins. thick were cut into slices and these were examined separately showed that virtually all the larvae recovered were from the top 1½ ins., even in winter.

Comparison of the recovery of *Tabanus* larvae by the two methods in three different areas indicated that, if recovery by the funnel method was complete, only about 13 per cent. were being brought to the surface in 40 minutes by the larvicide. The latter, moreover, was ineffective in cold weather and ineffective at any time for *Chrysops* larvae, which were shown to react to the irritant by contracting and becoming immobile. It cannot be used in the presence of free water, and mortality among larvae kept for rearing is considerable. On the other hand, there was much less variation between samples taken close together with this method than with the funnel method, and sampling could be completed in about an hour. The funnel method needs repeated examination for about a week for the recovery of all larvae, but it can be used in cold weather and in the presence of free water, both *Tabanus* and *Chrysops* larvae are collected, and more larvae survive if kept for rearing.

Gersdorff (W. A.), Piquett (P. G.) & Beroza (M.). **The Intensity of Synergism of some Methylenedioxyphenyl Acetals with Pyrethrins or Allethrin in House Fly Sprays.**—*J. econ. Ent.* **50** no. 4 pp. 406–409, 9 refs. Menasha, Wis., 1957.

Of 18 synthetic 3.4-methylenedioxyphenoxy compounds thought to warrant further investigation as synergists for pyrethrins or allethrin [*R.A.E.*, B **45** 214], five acetals were chosen for precise comparison in mixtures with each insecticide and a sixth was included in the study with the allethrin mixtures. The five compounds were 2-(2-n-butoxyethoxy)ethyl 3.4-methylenedioxyphenyl acetal of acetaldehyde and the corresponding ethoxyethoxyethyl, butoxyethyl, methoxyethyl and chloroethyl derivatives, and the sixth was the corresponding ethyl derivative. Purified samples were used, and they were tested in oil sprays containing synergist and insecticide in the proportion of 10:1 against *Musca domestica* L. by the turntable method [**26** 246]. The results are examined statistically. The acetates alone were not toxic. On the basis of the LD50, the mixtures of the butoxyethoxyethyl, ethoxyethoxyethyl, butoxyethyl, methoxyethyl and chloroethyl derivatives with pyrethrins were, respectively, about 22, 20, 12, 5·5 and 3·1 times as toxic as pyrethrins alone, mixtures of the derivatives, in the same order, with allethrin were about 3·6, 3·6, 3, 2·8 and 2·1 times as toxic as allethrin alone, and the mixture of the ethyl derivative with allethrin was 1·9 times as toxic as allethrin alone.

The butoxyethoxyethyl, ethoxyethoxyethyl and butoxyethyl derivatives were compared directly with sulfoxide [1.2-methylenedioxy-4-(2-(octylsulphinyl)propyl)benzene] and piperonyl butoxide as synergists with pyrethrins, and the first two were found to be superior to them [*cf.* also **45** 119]. Knockdown of flies was high for all mixtures at the concentrations used and complete for the insecticides alone. It is thought that the new compounds may contribute synergistically to knockdown action, but it would be necessary to carry out tests with lower concentrations to obtain definite information.

Gersdorff (W. A.), Piquett (P. G.) & Beroza (M.). **Comparative Effects of the Optical Forms of Epiasarinin, Asarinin, and Sesamin in Pyrethrum Mixtures as House Fly Sprays.**—*J. econ. Ent.* **50** no. 4 pp. 409–411, 4 refs. Menasha, Wis., 1957.

It was concluded from experiments in which *d*-sesamin, *l*-asarinin and *d*-asarinin (isosesamin) were used that spatial configuration is of little importance in the synergistic effect of these isomers with pyrethrins in kerosene sprays [*R.A.E.*, B **31** 8]. Two new isomers, *d*- and *l*-epiasarinin have since been prepared, and all five and *l*-sesamin were tested for synergism with pyrethrins against *Musca domestica* L. in kerosene sprays containing 10 per cent. acetone as an auxiliary solvent. The tests were made by the turntable method [**26** 246], and equal parts of insecticide and synergist were used in the mixtures. Sprays containing the isomers alone caused no knockdown or kill and those containing pyrethrins caused complete knockdown. Mortality data were examined statistically. On the basis of the LD50, mixtures containing *d*-sesamin, *l*-sesamin, *d*-asarinin, *l*-asarinin, *d*-epiasarinin and *l*-epiasarinin were about 3, 4·2, 2·4, 2·7, 2 and 1·9 times as toxic as pyrethrins alone. The figure for synergistic activity of *d*-sesamin was considerably higher in a previous study [**43** 157] but the error was unusually large, the toxicity due to acetone could not then be allowed for, and the use of unusually tolerant flies may also have had an effect.

In spite of some overlapping in the effects of the isomers, it is evident that the two sesamin compounds are more effective than the epiasarinin compounds. The only difference between the optical forms of a pair found to be significant was that between *l*- and *d*-sesamin. An equiproportional mixture of the two optically active forms of a given pair (the racemic mixture that is obtained on synthesis) would be expected to behave as the mixture of two similarly acting substances and not as a different compound. In the two replicates of a test in which *d*- and *dl*-sesamin were compared, they were equally effective. The slightly increased effect to be expected of the racemic mixture because of the greater effectiveness of *l*-sesamin was not apparent. When the data for each pair of active forms are combined, there is an indication of an upward trend in synergistic activity from *dl*-epiasarinin (2) to *dl*-asarinin (2·5) and from *dl*-asarinin to *dl*-sesamin (3·6), the difference between the first and second compounds being on the borderline of significance and that between the second and third clearly significant.

WILLIS (E. R.) & LEWIS (N.). **The Longevity of starved Cockroaches.**—*J. econ. Ent.* **50** no. 4 pp. 438–440, 8 refs. Menasha, Wis., 1957.

The duration of survival was determined for adults of both sexes of 11 species of cockroaches deprived of food, water or both. Temperature was maintained at 27°C. [80·6°F.] during the exposure period, and the relative humidity was 36–40 per cent. except for *Leucophaea maderae* (F.) and some of the females of *Blattella germanica* (L.), which were kept in 70 per cent. humidity. With neither food nor water, mean survival times of the species kept at 36–40 per cent. humidity ranged from 4·8 days for males of *B. vaga* Hebard to about 42 days for females of *Periplaneta americana* (L.). The larger species tended to survive longer than the smaller. Females of *L. maderae* survived more than 50 days without food or water, and this species alone survived much longer on dry food than with neither food nor water. Most species lived significantly longer at 36–40 per cent. humidity on water alone than on dry food alone, but water was not adequate to maintain life for as long as both water and food. It generally enabled females and often males also to survive for a month or more.

Data obtained in 1943–44 by J. Leclercq, and hitherto unpublished, are given on the effect of atmospheric humidity on survival in starved nymphs and adult males of *Blatta orientalis* L. They indicate that length of life of males was not affected by differences in relative humidity between 6 and 41 per cent. but that it increased regularly as relative humidity rose from 50 to 100 per cent. There was considerable variation from individual to individual at any one humidity. Data for definite conclusions on nymphs were insufficient, but it appeared that survival was longer at higher than at lower relative humidities.

BARKER (R. J.). **Some Effects of Temperature on Adult House Flies treated with DDT.**—*J. econ. Ent.* **50** no. 4 pp. 446–450. 3 graphs, 8 refs. Menasha, Wis., 1957.

The following is based on the author's summary of experiments on the effects of eight temperatures between 5 and 40°C. [41 and 104°F.] on the absorption and degradation of DDT in house-flies (*Musca domestica* L.) that were alive 24 hours after it had been applied topically to them. Untreated flies tolerated exposure to all the temperatures without adverse effects. The effects of DDT were manifested earlier at higher temperatures, and the symptoms of poisoning were telescoped. Survival increased as temperature increased from 15 to 30°C. [59 to 86°F.] but tended to decrease at temperatures above this.

Three strains of the fly, differing in their resistance to DDT, were used in the tests, but the amounts of DDT absorbed in the surviving flies did not differ from strain to strain. They increased with temperature and seemed closely correlated with the percentages of survivors. The degradation of DDT, as measured by the amount of DDE (1,1-bis(p-chlorophenyl)-2,2-dichloroethylene) and "non-Schechter-Haller metabolite" (absorbed DDT unaccounted for as DDT or DDE), was also higher at higher temperatures. The amount of unchanged DDT in the surviving insects was essentially constant for a given dosage regardless of temperature. It seemed to be self-limiting, any flies in which the internal DDT exceeded a critical limit being killed and thus excluded from analysis. By analysing only survivors, a lethal mechanism can be discerned, because it will remain constant as other factors vary. This search for a self-limiting constant is believed to be a unique approach to the detection of the lethal factor. It can reduce the confusion of cause and effect. The three strains studied did not show any differences except in mortality. This suggests that tolerant flies in these strains do not differ, and that the strains differ only in the number of these tolerant flies present.

ADKINS jr. (T. R.). **Field Evaluations of Dow ET-57 as a systemic Insecticide for the Control of the Common Cattle Grub in Alabama.**—*J. econ. Ent.* **50** no. 4 pp. 474–476, 2 refs. Menasha, Wis., 1957.

Tests of Dow ET-57 [purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] as a systemic insecticide against *Hypoderma lineatum* (Vill.) [*cf. R.A.E.*, B **46** 88, etc.] were carried out in four districts of Alabama in 1956. They involved 115 treated cows and heifers and 147 controls. The chemical was administered at 110 mg. per kg. body weight in boluses in all four districts and as a drench in two. Treatment was unavoidably made late in the season. At the end of the tests, the numbers of larvae per cow, in the backs of the untreated cattle, averaged for the four districts and (in brackets) the two in which the drench was used, were 6·83 (3·46) and the percentages of cows free from infestation were 22·2 (35·6). The corresponding figures for the cows treated with the boluses (or drench) were 0·92 (0·48) and 77 (76). The boluses and drench thus gave 86·5 and 86·1 per cent. control based on numbers of larvae and 70·4 and 62·7 per cent. based on numbers of cows infested, and the boluses are easier and safer to use.

LINDQUIST (D. A.) & DAHM (P. A.). **Some chemical and biological Experiments with Thiodan.**—*J. econ. Ent.* **50** no. 4 pp. 483–486, 3 figs., 2 refs. Menasha, Wis., 1957.

Thiodan (6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide) is apparently a mixture of two stereoisomers [*cf. R.A.E.*, A **46** 141]. These isomers were separated by column and paper chromatography. Ultraviolet spectra of purified Thiodan, its isomers and Thiodan alcohol (1,4,5,6,7,7-hexachloro-2,3-bis(hydroxymethyl)-bicyclo(2.2.1)heptene-5) obtained by acid hydrolysis of technical Thiodan yielded identical curves, but infra-red spectra showed significant differences between them. Analysis by paper chromatography and comparison of infra-red spectra showed that the alcohols obtained by hydrolysis of the isomers were identical with Thiodan alcohol, and that the reaction of either of the two alcohols with thionyl chloride yields Thiodan identical with purified Thiodan. It appeared that Thiodan alcohol consists of only one isomer, and that some rearrangement of it is caused by the reaction with thionyl chloride.

From the results of topical application of acetone solutions to females of a non-resistant strain of *Musca domestica* L., the LD50's in μg. per g. body weight and (in brackets) per fly were estimated to be 6·7 (0·15) for both technical and purified Thiodan, 6·2 (0·14) and 8·5 (0·19) for the two isomers and 9·4 (0·21) for DDT. The acute oral LD50 of purified Thiodan for male white rats was between 40 and 50 mg. per kg.

OUYE (M. T.) & KNUTSON (H.). **Reproductive Potential, Longevity and Weight of House Flies following Treatments of Larvae with Malathion.** —*J. econ. Ent.* **50** no. 4 pp. 490–493, 6 refs. Menasha, Wis., 1957.

An account is given of laboratory studies, carried out with house-flies (*Musca domestica* L.) of a strain that had had no previous exposure to insecticide, to determine the effect on certain aspects of their biology of exposure to malathion in the larval stage in three successive generations. The malathion was added to the rearing medium at 2 parts per million and produced 40–60 per cent. mortality in the first generation and little or none in the other two. The total number of eggs produced in three weeks by 8,500 females of the treated group (T) was 93 per cent. of the number produced by 8,500 controls (UT). Egg production in this strain is negligible after three weeks. The length of life of the T females based on cumulative female-days (the cumulative number of females remaining alive each day) was only 82 per cent. of that of UT females, but the average number of eggs per female-day was 14 per cent. greater in T flies. From a given number of eggs laid over a period of three weeks by T and (in brackets) UT females, the percentages producing larvae, pupae and adults were 72 (74), 64 (62) and 57 (56), respectively. Percentages of larvae pupating were 88 (83) and percentages of pupae giving rise to adults were 90 (91).

By combining data on egg production and survival of progeny, it is shown that T flies produced 12 per cent. more potential adult progeny than UT flies and that this resulted largely from differences during the first week of adult life. In this week, T females laid many more eggs than UT females and a much greater proportion of the eggs gave rise to adults, so that they produced 68 per cent. more adult progeny. Adult T progeny of both sexes from eggs laid during the first week of adult life weighed less than the progeny of UT parents.

Barker (R. J.). **DDT Absorption and Degradation in House Flies of varied Age.**—*J. econ. Ent.* **50** no. 4 pp. 499–500, 7 refs. Menasha, Wis., 1957.

House-flies (*Musca domestica* L.) of a DDT-resistant strain were treated topically with DDT 1–9 days after they had emerged and those that survived for 24 hours were analysed [*cf. R.A.E.*, B **46** 139]. The absorption and the total degradation of DDT seemed to be uninfluenced by age, but the "non-Schechter-Haller metabolite" was the predominant degradation product in the younger flies (except those treated three days after emergence) whereas DDE (1,1-bis(p-chlorophenyl)-2,2-dichloroethylene) was the predominant or only one in the older flies.

Neel (W. W.). **The Effectiveness of new Repellents for the Control of Horn Flies on Dairy Cattle.**—*J. econ. Ent.* **50** no. 4 pp. 502–503, 2 refs. Menasha, Wis., 1957.

The experiment described was carried out in Mississippi in August and September 1956 to determine the effect on control of the horn-fly (*Siphona irritans* (L.)) and on milk production of adding 5 per cent. butoxy polypropylene glycol [*cf. R.A.E.*, B **45** 142; **46** 90] or 1 per cent. Tabutrex (di-n-butyl succinate) as repellents to the standard dairy spray of 0·5 per cent. methoxy-DDT (methoxychlor). *S. irritans* was the only fly that was considered a nuisance at the time of the experiment. Test cows received about 0·25 U.S. gal. spray after the morning milking once a week for four weeks, and the sprayed cows and the controls were kept together. Fly counts were made in the morning on the second and fifth days after each treatment. On the second day, counts on all test animals (treated and untreated) were very low. The average numbers of horn-flies per cow on the fifth day in the four weeks of the experiment were 32·65, 22·35 and 27 on the cows sprayed with methoxy-DDT alone, with butoxy polypropylene glycol and with Tabutrex and 63·55 on the control cows. There was no significant difference between treatments, but a significant difference between any treatment and none. An analysis of daily milk production records kept during the test period gave no indication that the fly control improved milk flow, possibly because the flies were not very numerous.

Harwood (R. F.) & Areekul (S.). **A Rearing Trap for producing Pomace Flies for Bioassay of Insecticides.**—*J. econ. Ent.* **50** no. 4 pp. 512–513, 1 fig. Menasha, Wis., 1957.

When adults of *Drosophila melanogaster* Mg. of known age are required in large numbers for tests, collection from the culture jars is laborious. A procedure was therefore devised in which eight jars are attached beneath the top of a wooden box, through which the emerging adults, attracted by light, enter plastic tubes that ultimately lead to a removable screen cage, in the top of which a plug of cheesecloth soaked in 5 per cent. sucrose solution is inserted. The flies are removed every 24 hours, and it was found by observation of ovary development that only 1–2 per cent. of them had emerged more than 24 hours previously.

For continuous production culture jars of 1 U.S. gal. capacity are used. A half-inch layer of moistened canned pumpkin is placed in the bottom as rearing medium, with a few granules of dried live yeast sprinkled on top and a paper towel to serve as a pupation site, and 400 adults are liberated in each jar. These are removed after a week, and about eight days later, when the first new adults are about to emerge, the jars are placed in the box. With eight jars in the box and the oldest culture replaced daily, about 3,000 adults of both sexes were produced per day. Tests against insecticide deposits indicated that the population produced was homogeneous.

HOFFMAN (R. A.) & MONROE (R. E.). **Further Tests on the Control of Fly Larvae in Poultry and Cattle Manure.**—*J. econ. Ent.* **50** no. 4 p. 515, 1 ref. Menasha, Wis., 1957.

In a continuation in 1956 of experiments near Fresno, California, on the control of larvae of *Musca domestica* L. in poultry droppings [*cf. R.A.E.*, B **45** 178], various insecticides were used in sprays applied at 50 ml. per sq. ft. with a compressed-air sprayer to manure 3–6 ins. thick under caged hens on plots 50 sq. ft. in area. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] was the standard and was used both as a suspension and in an emulsion. The other insecticides tested were Guthion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] and Dow ET-14 [O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] in emulsions, Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] and thiourea in suspensions, calcium cyanamide in dry granular form, and Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate]. Neither thiourea, which was used at 0·005–0·5 lb. per plot nor calcium cyanamide used at 1–3 lb. gave appreciable kill of larvae, but plots treated with the latter dried out so that the larvae migrated from them and they did not become reinfested until a layer of new droppings was deposited. The other materials were applied at 25 mg. per sq. ft. and at various other rates between 5 and 100 mg. At 25 mg., diazinon in emulsion and as a suspension, Phosdrin, ET-14, Guthion and Dipterex reduced numbers of larvae by 96, 99, 91, 97, 79 and 83 per cent. in 48 hours and prevented reinfestation for at least 4, 4, 2, 3, 2 and 4 days, respectively. Phosdrin was highly toxic for 36 hours to flies alighting on the treated manure, and diazinon, unlike the other insecticides, usually prevented reinfestation for 8–9 days. Guthion was very erratic.

Diazinon in emulsion was also tested on stacked cattle manure. It was applied at 25–250 mg. insecticide per sq. ft. and 50–150 ml. spray per 50 sq. ft. The highest volume was needed to penetrate unbroken crust and, even with this rate of application, mortalities were variable. They never exceeded 80 per cent., and effectiveness was most evident at cracks. Mortality was consistently higher when the crust was mechanically broken before treatment, and reached 95–100 per cent. when application was at 100 mg. per sq. ft. or more.

DU TOIT (R.) & FIEDLER (O. G. H.). **A new Method of Treatment for Sheep infested with the Larvae of the Sheep Nasal-fly, *Oestrus ovis* L. in the Union of South Africa.**—*Onderstepoort J. vet. Res.* **27** no. 1 pp. 67–75, 3 figs., 17 refs. Pretoria, 1956.

Oestrus ovis L. is widespread in sheep throughout the Union of South Africa and is particularly prevalent in the east. Both the extent and intensity of infestation and the severity of its effects appear to have increased between 1940 and 1952. Its incidence is comparatively low in the cooler months and reaches a peak between October and January. Mature larvae have been found in lambs no more than a month old. The adults are rarely seen. and the immature larvae appear to be the most vulnerable stage, but there is no well-established control measure [*cf. R.A.E.*, B **46** 115–116, etc.]. In the method described. γ BHC (lindane) was injected into the nostrils of the sheep while it was held on its back with its head at an angle of 45° with the ground. To ensure penetration of the sinuses through the heavy mucoid secretion that is often present in heavily infested sheep, the BHC was introduced in a concentrate that would be emulsified in the serous discharges covering the mucous membrane. The ingredients in amounts per litre of the concentrate adopted after preliminary experiments were 125 ml. benzene, 125 ml. acetone and 100 ml. kerosene as solvents, 570 ml. technical sulphonated castor oil and 20 ml. Triton X 100 as emulsifiers, and 60 ml. oleic acid as an accessory solvent to keep the mixture clear and homogeneous. The γ BHC was included in this concentrate at 4 g. per 100 ml., and 4 ml. of the mixture was injected into each nostril. The sheep was held in position for ten seconds to allow gravity to help the penetration of the sinuses. The treatment was extremely well tolerated.

Nearly all of 2,865 apparently heavily infested sheep that received the treatment in the field in different parts of the Union were reported to be free of mucoid secretions after 9–14 days, and their condition improved markedly. A few sheep needed a second treatment after 2–3 weeks, and in one case a few needed a third. Three treatments at intervals of 3–4 weeks are recommended to kill freshly established larvae. Treating ewes and their suckling lambs impaired the sense of smell of both, so that the ewes were reluctant to accept their lambs and the lambs had difficulty in finding their mothers. Moreover, the treatment was fatal to very young lambs. The lambs that succumbed had received a dose equivalent to 40–60 mg. γ BHC per kg. and one that showed signs of poisoning but recovered had received 28 mg. per kg., whereas the dose received by adult sheep averaged only 8 mg. per kg. It is concluded that it is not advisable to treat lambs weighing less than 20 lb.

FIEDLER (O. G. H.) & DU TOIT (R.). **The Protection of Sheep against Blowfly Strike. IV. An Evaluation of certain organic Phosphorus Compounds.**—*Onderstepoort J. vet. Res.* **27** no. 1 pp. 77–81, 1 graph, 2 refs. Pretoria, 1956.

The results are given of tests in South Africa of the toxicity of six phosphorus compounds to first-instar larvae of *Lucilia cuprina* (Wied.) and, in particular, their effectiveness in protecting sheep from infestation. Diazinon [O.O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], parathion and EPN-300 [of which the active ingredient is O-ethyl O-p-nitrophenyl phenylphosphonothioate] were as toxic as the best of the others when added to the breeding medium of the larvae, killing all in less than 72 hours at a concentration of 0·25 p.p.m. [*cf. R.A.E.*, B **44** 89], and much the most effective when tested, by the methods already noticed [*loc. cit.*], for ability to diffuse in the wool of sheep and protect them from infestation. The average periods of protection in weeks were 51 for diazinon, 48·8 for parathion, 40·3 for EPN-300 and less than 9–24 for the others, and as parathion and EPN stain the wool and are highly toxic to mammals, it is concluded that diazinon is the only phosphorus compound that seems to comply with all the requirements of an agent for protecting sheep against blowflies. Its larvicidal action and its power of diffusion in the wool are both superior to those of dieldrin and BHC [*cf. loc. cit.*], which have proved very efficient in practice.

Bollow (H.). **Welcher Schädling ist das? Vorrats-, Material-, Haus- und Gesundheitsschädlinge.** [What Pest is that? Pests of Stored Products, Materials, Houses and Hygiene.]—Kosmos-Naturführer, 178 pp., 8 col. pls., text illus. Stuttgart, Franckh'sche Verlagshandl., 1958. Price *D.M.* 11.80 cloth; *D.M.* 9.80 paper cover.

One section of this book (pp. 115–166) is concerned with arthropods that affect the health of man or domestic animals in Germany. It comprises a short table showing the types of skin reaction caused in man by various biting or stinging insects and other arthropods, another in which the pests of domestic animals and poultry are listed by their German and scientific names under the host attacked, and a longer systematic table, in which information is given on the appearance of 149 pests injurious to man or animals, the type of injury caused and the recommended control measures. Many of the pests are figured, to assist recognition, and a glossary of terms used in connection with control work is appended; the latter includes notes on insecticides and acaricides.

Haufe (W. O.). **Physical Environment and Behaviour of immature Stages of *Aedes communis* (Deg.) (Diptera: Culicidae) in Subarctic Canada.**—*Canad. Ent.* **89** no. 3 pp. 120–139, 8 figs., 16 refs. Ottawa, 1957.

Observations near Fort Churchill, Manitoba, on natural breeding places of *Aëdes communis* (Deg.), a mosquito apparently typical of the local pest species of *Aëdes* in subarctic Canada, indicated that the behaviour of the larvae in regular-shaped and partly sunlit pools was influenced by the peculiar conditions of light and temperature resulting largely from the low angle of inclination of the sun to the horizontal, with consequent horizontal as well as vertical temperature gradients, and that rates of development cannot be adequately estimated from time-temperature relations unless corrections are made for behaviour. When the mean temperature at one inch below the surface of the water was below that preferred for the species, the larvae aggregated in areas as much as 4°F. above the mean temperature. Larvae aggregated temporarily at greater depths in the pool when the temperature of the surface layers of water exceeded the preferred temperature.

Bearcroft (W. G. C.). **Zika Virus Infection experimentally induced in a Human Volunteer.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 5 pp. 442–448, 1 graph, 14 refs. London, 1956.

The following is based on the author's summary. A man was inoculated with the Nigerian strain of Zika virus [*R.A.E.*, B **46** 97]. After an incubation period of 82 hours, a mild, short-lived febrile condition occurred without evidence of involvement of any particular tissue or viscus. Zika virus was isolated from his blood during the febrile period, but the titre did not exceed 1 mouse LD50 for 0·03 ml. serum, and females of *Aëdes aegypti* (L.) fed on him did not infect baby mice on which they were fed or baby or adult mice into which they were inoculated. A rise in serum antibody to both Zika and yellow-fever viruses was demonstrated by both mouse-protection and haemagglutination-inhibition tests.

Smith (S. A.). **Some Observations on the Breeding of *Taeniorhynchus* (*Mansonioides*) *africanus* (Theo.) in the Laboratory.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 5 pp. 458–459, 2 refs. London, 1956.

Mosquitos of the genus *Mansonia* (*Taeniorhynchus*) are particularly difficult to establish in laboratory culture because the larvae and pupae attach themselves for respiration to the underwater roots of floating plants. An attempt was made to establish a colony of *M.* (*T.*) *africana* (Theo.) in a London laboratory from eggs sent by air from Uganda. A culture of *Salvinia auriculata*, a small spreading water plant, was first established. *Eichhornia* and *Pistia* proved unsatisfactory. The eggs were sent between wads of moist cotton-wool and filter paper in sealed perspex tubes. On arrival, they were put in 100 ml. tap-water at 25°C. [77°F.] in a 200-ml. beaker, which was kept at this temperature in an incubator until the eggs hatched or died. If they hatched, the beaker was filled with an infusion of dog-biscuit, a sprig of *Salvinia* was floated on the surface, and the beaker was kept in the laboratory at an air temperature of about 27°C. [80·6°F.] and a water temperature of 25°C. The larvae attached themselves to the roots of the plant. Twice weekly for 3–4 weeks, one-third of the water was removed and replaced by dog-biscuit infusion and a fresh piece of *Salvinia* was added. When pupae formed, the plants with pupae attached were transferred to clean tap-water. The adults emerged into a cubic cage of mosquito netting with sides 10 ins. long, over which a damp white cloth was draped to maintain a humid atmosphere. Nine males and 12 females were obtained from one batch of 100 eggs. The females fed readily on the human arm, and soaked raisin and sugar solution were also provided. Two females that died after 21 days were found on dissection to contain almost mature eggs and to have abundant and active spermatozoa in the spermathecae. One of the remaining females laid a perfect egg-mass next day on the underside of a *Salvinia* leaf. Other females died, possibly as a result of falls in temperature at night, but the temperature was then maintained at 26°C. [78·8°F.], and a further egg-mass was laid. The last two females died four weeks after they had emerged. Larvae hatched from the first egg-mass six days after oviposition, but died in a few days. Only one larva hatched from the second egg-mass.

The eggs received from Uganda did not hatch unless they were put in water within four days of having been laid. The dog-biscuit infusion was a satisfactory food only if it was rich in infusoria. A suitable condition was attained if a mixture of 6 g. powdered dog-biscuit in 500 ml. tap water was allowed to stand for five days.

MACDONALD (G.). **The Epidemiology and Control of Malaria.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., xv + 201 + xl + 11 pp., 17 figs., many refs. London, Oxford Univ. Pr., 1957. Price £1 10*s*.

The author points out that the major advances that have been made in the last half-century in the understanding of the epidemiology of malaria have stemmed from biological studies, which have greatly enhanced knowledge of the parasite, man's reaction to it, its development in the mosquito and the biology of the latter, but that elaboration of such studies cannot lead to a full understanding of the disease. There are few places in the world for which the local epidemiology is not recorded in considerable detail, but the mass of data fails to explain differences in happenings in places where they might be expected to be similar. What is lacking is a method of estimating the effect of a change in a particular factor, such as mosquito abundance or biting frequency, on the amount of malaria. Such an explanation of the relationship between one event and another can be supplied only by mathematics. The object of this work is to describe the epidemiology and control of malaria with the help of mathematics.

Four chapters are devoted to expositions of the cycle of transmission (stages of the parasite in man and in the mosquito) and the concepts and mutual relationships that can be derived mathematically from it and explain the occurrence of stable or unstable endemic malaria and of epidemics. The most important concept is the malaria reproduction rate [*cf*. *R.A.E.*, B **42** 82], and one of the factors greatly affecting this rate is the average number of feeds taken on man by a female of the vector in the course of its life. This is illustrated by comparison of the situation in Madras, where *Anopheles culicifacies* Giles has an expectation of life of about 3·8 days, and in East Africa, where *A. gambiae* Giles has an expectation of life of 13 days and the probability of its feeding on man in a normal lifetime is about 136 times as great as for *A. culicifacies*. The result is that malaria is stable in East Africa and unstable in Madras. A classification of some of the chief vectors is given, according to whether they are likely to cause stable or unstable malaria or malaria of medium stability. These chapters are followed by one in which the vectors and local features of epidemiology in the various malarious zones of the world are reviewed and eight concerned with control.

Recommendations on the making of a malaria survey in its various aspects preface an exposition of the interpretation of the survey data and the theory of control, the object of which is to reduce the reproduction rate below one. Chapters on means of control include reviews of the insecticides in wide use and of drugs used in prophylaxis and treatment, and information on the organisation of campaigns against Anophelines. The concepts of malaria eradication and vector eradication are also discussed, and there is an exposition of insecticide resistance, its detection in a natural population of an Anopheline and the practical implications of the finding of evidence of resistant genes.

The mathematical processes involved, and techniques used in making surveys, determining the susceptibility of Anophelines to insecticides, detecting resistance, testing insecticides in the field and examining them chemically are set out in appendices.

NEOGY (B. P.) & KACHROO (P.). **Observations on Association of aquatic Vegetation with Anopheline-breeding within Damodar-Eden Canal Area of West Bengal.**—*Indian J. Malar.* **10** no. 3 pp. 183–197, 2 pls., 3 graphs, 3 maps, 9 refs. Kanpur, 1956.

The aquatic vegetation of reservoirs, ponds and dobas (small depressions that hold water but may dry up during winter) is grouped into eight types, on the basis of a classification given by Hess & Hall [*R.A.E.*, B **34** 139], and the relationship of the various types to Anopheline breeding as observed in the Damodar-Eden Canal area of West Bengal in 1954 is discussed. Vegetation with floating leaves was most favourable for breeding. Flexuous vegetation (leafy emergent plants with patches of plants with floating leaves) can rise and fall to some extent with water level, and this type and floating-mat vegetation had high breeding potentials. Fewer larvae were associated with carpet-type vegetation covering the whole water surface, and very few or none with plants of the other four types (erect leafy, submerged, minute free-floating and microscopic). *Anopheles annularis* Wulp was particularly abundant among floating-leaf vegetation and followed the general trend in the other types. *A. pallidus* Theo. was about equally plentiful among floating-leaf, flexuous and carpet vegetation. *A. culicifacies* Giles was most plentiful in floating-leaf vegetation and *A. philippinensis* Ludl. in floating mat, but the numbers of these two species collected were very small.

The rice-fields and the pools in fallow land both have a mainly terrestrial or semiaquatic flora, yet few Anopheline larvae were found in the former and many more in the latter. The discrepancy in breeding cannot be attributed to lack of food for the larvae in the rice-fields, as the supply is similar, or to the action of natural enemies, as these are most numerous where larvae are most abundant. Anopheline production is much greater in low-lying land where the flora is aquatic, sometimes submerged but often with the floating type predominating, than it is in fallow land with semi-aquatic vegetation, and, as it is negligible in the rice-fields, it could probably be reduced by increased cultivation if the remaining uncultivated land was made dry by filling with earth.

Observation of changes in vegetation cover in a reservoir and corresponding changes in Anopheline production showed that breeding was favoured by a broken mat but fell rapidly when the whole water surface became covered. On the other hand, in pools with mixed vegetation, larvae were most numerous when most of the vegetation was emergent, decreased as submerged vegetation became dominant and became rare in the absence of both. A list is given of plant species that are indicative of Anopheline breeding, and the species of *Anopheles* most often associated with many of them are indicated.

Kant (L.), Sen (S. K.) & Puri (B. S.). **Filariasis in Patna (Bihar). Part I.**—*Indian J. Malar.* **10** no. 3 pp. 199–217, 7 graphs, 1 map, 6 refs. Kanpur, 1956.

A survey of the incidence of filariasis in the eastern part of Patna (Bihar) was made between December 1955 and April 1956. The endemicity rate among 9,485 people examined was 42·7 per cent., and the percentages of them showing signs of filariasis and microfilariae in the blood were 30·1 and 18·7, respectively. The only species of filaria found was *Wuchereria bancrofti*. Mosquitos were collected fortnightly, and nine species were taken. The females were dissected soon after collection. Infection was found in 11·9 per cent. of 1.487 females of *Culex pipiens fatigans* Wied. but in none of 184 other mosquitos, including 152 of the genus *Anopheles*. *C. p. fatigans* bred in cesspools, stagnant pools in drains, reservoirs, disused wells and ponds and natural collections of water.

Jaswant Singh, Raghavan (N. G. S.) & Krishnaswami (A. K.). **Filariasis in Travancore-Cochin State. I. Ernakulam and Mattancherri.**—*Indian J. Malar.* **10** no. 3 pp. 219–238, 8 graphs, 4 maps, 4 refs. Kanpur, 1956.

A filariasis survey of the towns of Ernakulam and Mattancherri in the State of Kerala (Travancore-Cochin) was made between October 1954 and March 1955. The endemicity and microfilaria rates were 10·6 and 7·6 per cent. among 7.328 people examined at Ernakulam and 21·7 and 14·7 per cent. among 4.017 examined at Mattancherri. Most of the infections were with *Wuchereria bancrofti*, but *W. malayi* was found in semi-rural areas. Twelve species of mosquitos were recorded during the survey and two more later. Filarial larvae were found in 50 of 1.654 females of *Culex pipiens fatigans* Wied., three of 350 of *Mansonia* (*Mansonioides*) *uniformis* (Theo.) and one of 99 of *M.* (*M.*) *annulifera* (Theo.) from Ernakulam and in 68 of 1.240 of *C. p. fatigans* and one of 56 of *M. annulifera* from Mattancherri. *C. p. fatigans* bred mainly in stagnant or sluggish drains and cesspools. The species of *Mansonia* bred in ponds covered with *Pistia stratiotes* in the peripheral wards, and these were the wards in which *W. malayi* was found in the people.

JASWANT SINGH, KRISHNASWAMI (A. K.), RAGHAVAN (N. G. S.), KRISHNAMURTHY (B. S.) & MAMMEN (M. L.). **Field Studies on the comparative Effectiveness of D.D.T., B.H.C. and Dieldrin residual Sprays against the Vectors of Wuchererian Infections.**—*Indian J. Malar.* **10** no. 3 pp. 239–259, 7 graphs, 2 maps, 8 refs. Kanpur, 1956.

The vector of *Wuchereria bancrofti* in the State of Kerala (Travancore-Cochin) is *Culex pipiens fatigans* Wied., and the vectors of *W. malayi* are species of *Mansonia* (*Mansonioides*) [see preceding abstract]. Tests of BHC and dieldrin against *C. p. fatigans* were made in parts of the town of Ernakulam in 1954 and of BHC, dieldrin and DDT against *Mansonia* in some villages in the coastal area with endemicity rates of more than 20 per cent. Water-dispersible powders were used in all cases and were applied in houses to give deposits of 44 mg. γ BHC, 200 mg. DDT or 50 mg. dieldrin per sq. ft. The walls and roof were sprayed as high up as possible. About half the dwellings in the town were of masonry with plastered walls, but nearly all of those in the villages were thatched huts with coconut-leaf roofing and walls of coconut leaf or bamboo matting. As most of the surfaces treated were non-absorbent, the volume of spray had to be restricted to 1 gal. per 2,000 sq. ft. At this rate, the dieldrin could be applied in one operation, but two applications of DDT and BHC were made, as the concentration needed to give the required deposit in one would have clogged the spray nozzles. BHC and dieldrin were both highly effective against *C. p. fatigans* for 13–14 weeks. BHC, DDT and dieldrin appeared to remain effective for 20 weeks against *Mansonia* and for 11, 8 and 12 weeks, respectively, against other mosquitos. Moreover, no filarial larvae were found in any of 634 females of *Mansonia* collected in the village areas in which the sprays had been applied, whereas 60 of 905 females from a control area were infected.

MARKS (E. N.). **A new Species of *Anopheles* from Queensland and Notes on related Species (Diptera: Culicidae).**—*Proc. roy. Soc. Qd* **67** (1955) pp. 41–52, 12 figs., 13 refs. Brisbane, 1956.

The following is virtually the author's synopsis. The adults of both sexes, pupa and larva of *Anopheles colledgei*, sp. n., are described from northern Queensland. It breeds in association with, and is closely related to, *A. stigmaticus* Skuse. Four forms of *A. stigmaticus* can be recognised in Queensland. Distinctive characters, notes on biology and distribution records are given for these and for *A. colledgei* and *A. powelli* Lee [*R.A.E.*, B **33** 94].

PAPERS NOTICED BY TITLE ONLY.

BROWN (N. C.), HOLLINSHEAD (D. T.), PHIPERS (R. F.) & WOOD (M. C.). **Application of Chromatography to Analysis of Pyrethrins.**—*Soap & chem. Spec.* **33** no. 9 pp. 87, 89, 91, 93, 119–120; no. 10 pp. 91, 93, 97, 99, 109, 113, 115, 6 graphs, 25 refs. New York, N. Y., 1957.

WEIDHAAS (D. E.). **Adsorption of DDT, Methoxychlor** [methoxy-DDT] **and some related Compounds on Insecticide Dust Diluents and Carriers.**—*J. econ. Ent.* **50** no. 4 pp. 429–435, 2 graphs, 9 refs. Menasha, Wis., 1957. [See *R.A.E.*, A **46** 339.]

FISCHER (L.) & STEINHART (W.). **Malaria und Malariaüberträger in Sarobie (Afghanistan).** [Malaria and its Vectors in Sarobie.]—*Z. Tropenmed. u. Parasit.* **8** pt. 1–2 pp. 69–83, 7 figs., 23 refs. Stuttgart, 1957.

The results are given of investigations on Anophelines and malaria carried out in 1951–52 at Sarobie, a village about 3,500 ft. above sea level in the arid subtropic zone of Afghanistan about 34 miles east of Kabul. It is situated between the Kabul river and one of its tributaries and near their point of confluence, where construction of a power station was in progress. The dry season lasts from about June to November, and temperatures are highest at the beginning of it, but transmission of malaria did not occur to any extent before July and reached a peak in October. The species of *Anopheles* found were *A. superpictus* Grassi, *A. stephensi* List. and *A. hyrcanus* (Pall.), and all available evidence indicated that *A. superpictus* was the vector. All three species bred in rice-fields near the village and in pools left in the beds of the rivers as the dry season advanced, but the rice-fields were almost the only breeding places of *A. stephensi* and *A. hyrcanus* and quite negligible as breeding places of *A. superpictus*, which increased in abundance during the malaria season when the pools became available for it. This was also the only period in which a few of the mosquitos were regularly found in houses, where *A. superpictus* outnumbered *A. stephensi* by about three to one and *A. hyrcanus* was not taken at all.

Malaria parasites were found in only one of 388 females of *A. superpictus* taken in houses and in none of 143 of *A. stephensi*. The incidence of malaria was much higher than would be expected from the small numbers of mosquitos found in dwellings, but the local habit of sleeping out of doors in hot weather may account for this. It also appeared that the mosquitos enter houses to feed at night and do not rest there during the day as *A. superpictus* does in Kabul [*R.A.E.*, B **43** 110], possibly because the drier climate of Sarobie forces them to seek moister situations out of doors.

The pools in which *A. superpictus* bred were 1–1·5 miles from the houses, a distance well within its flight-range [*loc. cit.*]. Attempts to control it by treating the houses or the pools with DDT were unsuccessful, and it is thought that its control requires large-scale regulation of river flow, possibly supplemented by insecticide treatments.

MARKS (E. N.) & RAGEAU (J.). ***Culex pipiens australicus*** **Dobrotworsky and Drummond in New Caledonia.**—*Proc. Linn. Soc. N. S. W.* **82** pt. 1 p. 156, 1 ref. Sydney, 1957.

Larvae of *Culex pipiens australicus* Dobr. & Drum. were found in rock pools in New Caledonia in June and July 1955. This is the first record of *C. p. australicus* outside Australia. The larvae had a longer siphon than Australian ones, which suggests that the mosquito is not of recent introduction into New Caledonia.

SAUTET (J.) & VUILLET (J.). **Sensibilité des larves de deux souches d'*Aedes aegypti* aux insecticides chlorés.**—*Bull. Soc. Path. exot.* **49** no. 2 pp. 333–335, 2 refs. Paris, 1956.

SAUTET (J.), ALDIGHIERI (R.) & VUILLET (J.). **Accoutumance expérimentale à un insecticide à base de D.D.T. d'une souche d'*Aedes aegypti* en provenance de Haïti et comparaison avec des souches d'autres provenances.**—*Méd. trop.* **17** no. 2 pp. 246–250, 2 figs., 1 ref. Marseilles, 1957.

In the first paper, the results are given of comparative tests of the toxicity of DDT to larvae of *Aëdes aegypti* (L.) of a strain from Haiti and a

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laboratory strain made in view of the finding of evidence of resistance to DDT in *A. aegypti* in Trinidad [*R.A.E.*, B **46** 109]. The numbers of fourth-instar larvae that were alive after 48 hours' exposure to DDT at dilutions of one and two parts per hundred million out of (in brackets) the numbers exposed were 59 (156) and 42 (136) for the Haiti strain as compared with 3 (86) and 0 (46) of the laboratory strain. The corresponding numbers of second-instar larvae were 6 (43) and 4 (54) as compared with 0 (44) and 0 (42). Experiments with smaller numbers of pupae in higher concentrations of DDT did not show clear-cut differences between the strains.

An attempt to raise the resistance of the Haiti strain by exposing the fourth-instar larvae of successive generations to a concentration of DDT that killed about 72 per cent. of the first is described in the second paper. Tests were made of the resistance of larvae of the first four generations, and three other strains, including the resistant one from Trinidad, were used for comparison. When the test concentration was a little more than twice as high as that used for selection, the percentages of larvae dead in 48 hours and (in brackets) four days were only 30·9 (30·9) for the fourth generation of the Haiti strain, as compared with 84·8 (96·6) for the first (untreated) generation, 83·7 (87·5) for the Trinidad strain and 100 (100) for the other two strains.

GOINY (H.), VAN SOMEREN (E. C. C.) & HEISCH (R. B.). **The Eggs of** *Aedes* (*Skusea*) *pembaensis* **Theobald discovered on Crabs.**—*E. Afr. med. J.* **34** no. 1 pp. 1–2, 2 figs., 1 ref. Nairobi, 1957.

A brief description and figures are given of the hitherto unknown eggs of *Aëdes pembaensis* (Theo.), which has been shown to be a vector of filariasis [caused by *Wuchereria bancrofti*] in Kenya [*R.A.E.*, B **46** 128] and breeds in crab holes. The eggs were found in rows on the legs of crabs of three species, most commonly on *Sesarma meinerti* de Man, on tidal flats at Changamwe, near Mombasa, and also on crabs on the Island of Patta, off the Kenya coast. When crabs (*S. meinerti*) were freed of *Aëdes* eggs and put in a cage containing artificially constructed crab holes, sea water and wild-caught adults of *A. pembaensis*, eggs were present on all the crabs after a week, and the mosquitos were sometimes observed ovipositing on them. The larvae have, however, been found occasionally in pools, swamps, bamboo pots, tree holes and domestic utensils, as well as in crab holes.

HALCROW (J. G.). **A new Sub-species of** *Anopheles gambiae* **Giles from Mauritius.**—*E. Afr. med. J.* **34** no. 4 pp. 133–135, 1 ref. Nairobi, 1957.

The form of *Anopheles gambiae* Giles that breeds in salt water in Mauritius [*cf. R.A.E.*, B **39** 47, etc.] is considered to represent a subspecies distinct from *A. g. gambiae* and *A. g. melas* Theo., and the new name *litoralis* [preoccupied in *Anopheles* (**20** 92)] is proposed for it. Its larvae are found in water of high salinity in crab-holes, depressions in coralline rocks, small tidal lagoons, pools close to the tidal zone and salt-pans, and are not associated with mangroves. Of fourth-instar larvae exposed in waters containing 35 and 45 g. sodium chloride per litre, 100 and 95 per cent. pupated, whereas fourth-instar larvae of *A. g. gambiae* all succumbed in water containing 16–17 g. per litre. Second-, third- and fourth-instar larvae of *A. g. gambiae* introduced into a breeding pool of *litoralis*, which had a salinity of 20·4 g. sodium chloride per litre, were all found dead within 12 hours. The eggs, larvae and pupae of *litoralis* resemble those of

A. g. gambiae, but the larvae and pupae are usually paler, possibly through reaction to the white coralline sand. The adults are distinguished by the much more constant possession of the fourth band on the maxillary palp. Of 218 reared adults of *litoralis*, 92 per cent. had four bands on the palps, whereas 94 per cent. of 147 of *A. g. gambiae* had three. It is suggested that the subspecies is a direct descendant of the East African coastal *gambiae*, which may have been introduced into Mauritius some 900 years ago by Arab slave-traders. It breeds only in the coastal zone of Mauritius, including islets inside the coastal reef and has not been found in the other Mascarene islands (Réunion and Rodrigues).

A. g. litoralis is relatively more abundant than *A. g. gambiae* in winter because its breeding pools are not affected by winter drought. They are remote from centres of human activity, and the adults are rarely found in dwellings or animal shelters. Smears of blood from the stomachs of females resting in cowsheds comprised 28 positive for cattle and six negative for man and cattle, and smears from females from houses comprised two positive for man and one for cattle, two negative for man and cattle, and one positive for dog and five for sheep or goat. In captivity, the females feed readily on man, deer, cow, rabbit and guineapig. Nothing is known of their ability to transmit malaria or filariasis [*Wuchereria bancrofti* (*cf.* **45** 32)]. Egg batches laid by *A. g. litoralis* and *A. g. gambiae* in captivity contained 50–70 and 100–222 eggs, respectively. When *gambiae* females and *litoralis* males were put together in the proportion of 5 : 1, the fertilisation index was 22 per cent., and the F_1 progeny consisted of four-banded males, three-banded females and one five-banded female. The fertilisation index for the reciprocal cross was 24 per cent.

CHRISTIE (M.). **The statistical Treatment of the Sporozoite Rate in Anopheline Mosquitoes.**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 350–354, 1 fig., 2 refs. Liverpool, 1956.

The following is virtually the author's summary of this paper, the purpose of which is to explain the application of standard statistical methods to an observed sporozoite rate (the percentage of females of a species of *Anopheles* positive for malaria sporozoites in a sample dissected) so as to appraise the accuracy with which it represents the true sporozoite rate in the whole population under consideration. The observed sporozoite rate is assumed to have a binomial distribution, the parameters of which are the true sporozoite rate and the size of the sample dissected. An explanation is given of the method of calculating the limits within which the true sporozoite rate is almost certain to lie. The validity of the binomial model is examined, and alternative assumptions are indicated. The size of the sample to be taken is briefly discussed.

GILLETT (J. D.). **Genetic Differences affecting Egg-laying in the Mosquito *Aëdes (Stegomyia) aegypti* (Linnaeus).**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 362–374, 32 refs. Liverpool, 1956.

The following is almost entirely based on the author's summary. A strain of *Aëdes aegypti* (L.) from Lagos (Nigeria) and one from Newala (Tanganyika) differ in their ability to lay eggs without the stimulus that follows mating [*R.A.E.*, B **44** 184]. Ovarian development follows a blood-meal in both strains [see next abstract], but whereas ovulation of the ripe oöcytes ensues in unmated Lagos females, it practically never does so in unmated Newala females. Apparently, the Newala females do not produce the ovulation hormone unless the spermathecae have been filled with seminal fluid. Ovulation of all ripe oocytes by unmated females seldom occurs in either strain. Reciprocal crossing between the two strains resulted in an intermediate condition, about half the unmated F_1 fed females laying eggs. When F_1 adults were mated to produce F_2 crosses by all the four possible combinations, the combined results very closely resembled those obtained in the F_1. Back-crosses to either parent strain produced results approaching those found in females of the strain to which the back-cross was made.

Analysis of the results is complicated by the fact that there is inherent variation in the number of ripe oocytes ovulated, even in the parent stocks. Nevertheless, the results clearly show that production of the ovulation hormone has a genetic basis. They are discussed and compared with previous findings in other Diptera [**12** 106; **17** 100; **21** 247; **25** 135; **45** 103], and the practical importance of intraspecific differences in behaviour is stressed. It is considered possible that differences in the susceptibility of *A. aegypti* to infection with the virus of eastern equine encephalitis [**24** 172] may have a hormonal origin with a genetic basis, as may differences in the biting behaviour of *A. simpsoni* (Theo.) that appear to be intimately concerned with the epidemiology of yellow fever in Uganda [**41** 161; **45** 20].

GILLETT (J. D.). **Initiation and Promotion of Ovarian Development in the Mosquito** *Aëdes* (*Stegomyia*) *aegypti* (**Linnaeus**).—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 375–380, 22 refs. Liverpool, 1956.

The results are given of experiments carried out in 1955 and 1956 with females of *Aëdes aegypti* (L.) that were given a blood-meal after having been maintained on raisins for the first two days of adult life. They were decapitated at intervals of 0–15 hours after the blood-meal, the neck wound being sealed with hot wax, and their ovaries were examined three days later. The tests in 1955 were on the Lagos strain of the species, but a strain from Rantau Panjang (Malaya) and both the Lagos and Newala strains [*cf.* preceding abstract] were used in 1956. Decapitation prevented ovarian development to maturity if it was carried out before a critical period (8–14 hours after the blood-meal at 28°C. [82·4°F.] in the two African strains and possibly a little earlier in the Malayan strain). Development of the oocytes began, but stopped short at or before stage 3 [*cf. R.A.E.*, B **29** 93], whereas it proceeded to maturity (stage 5) in females decapitated after the critical period. It is concluded that, in *A. aegypti*, ovarian development beyond the resting stage (stage 2) is a two-step process of initiation and promotion. Development is initiated in some way by the taking of a blood-meal, but promotion of the oocytes to full term depends on release of a hormone, presumably from the neurosecretory cells of the brain. It seems likely that release of this hormone into the haemolymph results in mobilisation of nutrient materials present in the blood-meal for further development of the oocytes.

These results are compared with those of Detinova [**34** 138] and Clements [**45** 103]. Detinova found that development of the ovaries of *Anopheles maculipennis* Mg. was prevented by ligation behind the corpora alata soon after the blood-meal but not by ligation at the neck, indicating that a gonadotrophic hormone was released from the corpora alata. It is possible that the decapitation technique used for *Aëdes aegypti* may have resulted in some injury to the corpora alata or other endocrine organs in the anterior part of the prothorax, or alternatively that secretions from the cells of the brain and from the corpora alata may both play a part, the one serving to activate the other. Clements found that decapitated females of *Culex* *pipiens molestus* Forsk. showed a critical period of about seven hours after emergence, whereas those ligated at the base of the abdomen showed a critical period of about five hours. He failed to find evidence of hormonal control of ovary development in *A. aegypti*, and this is why the author's experiments with three strains were undertaken in 1956.

GILLETT (J. D.). **Variation in the Time of Release of the Ovarian Development Hormone in** *Aëdes aegypti*.—*Nature* **180** no. 4587 pp. 656–657. 8 refs. London, 1957.

To investigate more closely the critical period during which the ovarian-development hormone is released in *Aëdes aegypti* (L.) [*cf.* preceding abstract], some females (group A) of a strain from Lagos were given raisins for two hours on the day of emergence, whereas others (group B) were kept without raisins. All the mosquitos were given a blood-meal on the second day after emergence, when a trace of fruit juice was still visible in the ventral diverticulum of those of group A, and were then kept at 28°C. [82·4°F.]. At intervals of 20 minutes for 14 hours after the blood-meal, successive batches of four from each group were decapitated. Observations on group A were subsequently extended to 16 hours. As previous unpublished work had shown that decapitated females of *A. aegypti* do not lay the eggs that they may have developed even if previously mated, both groups were dissected on the fourth day to see what proportion contained mature oocytes. Mosquitos dying prematurely were excluded. The results, which are given in a table, showed that feeding on fruit delayed the development of the oocytes. The percentages of females of group A and (in brackets) group B that developed mature oocytes after decapitation in the two-hour periods ending 4, 6, 8, 10 and 12 hours after the blood-meal were, respectively, 0 (8), 13 (50), 42 (79), 46 (92) and 71 (96). It seems possible that the ovarian-development hormone is normally released in response to stretching of the abdomen with blood. Partial distension of the abdomen by filling of the diverticula with fruit juice may perhaps lead to premature release of the hormone and to its dissipation before the blood-meal is taken, or distension of the ventral diverticulum may limit the amount of blood that can be taken into the stomach and so affect a quantitative relation that may exist between the degree of stretching of the stomach and the time of hormone release. It is possible, however, that the presence of fruit juice or its derivative acts in a less direct way.

MACDONALD (W. W.). *Aëdes aegypti* **in Malaya. I. Distribution and Dispersal.**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 385–398, 1 map, 25 refs. Liverpool, 1956. **II. Larval and Adult Biology.**—*T. c.* pp. 399–414, 1 graph, 50 refs.

At a conference on virus diseases held at Kuala Lumpur in 1954, the risk of the introduction of yellow fever into Asia was reaffirmed and it was resolved that the distribution and biology of *Aëdes aegypti* (L.) in Malaya should be studied and methods of control investigated. The observations on distribution and biology, respectively, are the subjects of these two papers. Investigations on control will be reported upon in a third.

Surveys showed that *A. aegypti*, which was principally a species of coastal towns in Malaya fifty years ago, is now also widespread inland and has reached a high density in many inland towns. The mean *aegypti* index for 803 coastal-town shop-houses (brick buildings with commercial premises at the front on the ground floor and residential accommodation behind and on the first floor) was 38 per cent. and that for 848 inland-town shop-houses was 34 per cent.; the comparable indices in coastal and inland villages were 32 and 18 per cent. Indices were generally much higher in slum-houses (wooden houses roofed with galvanised iron or palm thatch) because there were more water-storage containers than in shop-houses. Indices were lower in Singapore than in the Federation of Malaya, probably partly because of differences in water supply. *A. aegypti* was not found in the labourers' quarters of four rubber estates examined; its absence is attributed to good maintenance of living quarters and little water storage. The methods and rates of dispersal are discussed, and it is concluded that the most important method is the mechanical transport of one or other of the life-stages, generally the eggs. Once a focus has become established in this way, consolidation and local dispersal by flying adults follow rather slowly. The spread of *A. aegypti* in Malaya is by no means complete. It is now firmly established in the towns and in the coastal villages, among which its dispersal is probably helped by junks sailing up and down the coast. The next phase in dispersal is likely to be its colonisation of rural areas, from many of which it is still absent.

The nature and situation of the breeding places of *A. aegypti* in Malaya are summarised, and attention is drawn to the possibility of its spreading from its present domestic habitat to outdoor niches. The results of laboratory tests indicated that competition with *A. albopictus* (Skuse) would not seriously hinder such expansion, as more adults of *aegypti* than of *albopictus* emerged in all of several experiments in which equal numbers of larvae of the two species were reared together. In and near shop-houses, slum-houses and kampong houses (detached wooden village houses raised off the ground), outdoor breeding places formed 24, 34 and 54 per cent., respectively, of all breeding places found. Ant-traps (cups of water in which the legs of food-cupboards are stood) were among the most frequent breeding places in shop-houses and slum-houses and were used for oviposition about as often as earthenware jars. The latter were much the most important in kampong houses in which ant-traps are seldom used. No larvae of *A. aegypti* were found in a short survey of plant axils [*cf. R.A.E.*, B **30** 123; **36** 205], but some were found in tree-holes, tree-stumps and bamboo stumps.

The adults are active and bite mainly by day. The periods of greatest activity were found to be mid-morning and late afternoon. The females fed repeatedly at short intervals in nature, doing so even when already blood-fed, semi-gravid or gravid. This undoubtedly increases the potentialities of the species as a vector of disease. In the laboratory, the first blood-meal was generally taken on the second day after emergence. The gonotrophic cycle generally lasted 2–3 days, but might last as long as six. Poor conditions of life for the larvae resulted in a high proportion of adults incapable of developing eggs after a single blood-meal, and in poor egg production. There is little doubt that females from well-fed larvae emerge with fat reserves sufficient to develop their ovaries to stage 2 [*cf.* **46** 152], with the result that the blood-meal can be used directly for development beyond this stage, whereas other adults probably need a blood-meal to develop ovaries to stage 2 and another for development to stage 5. Other factors that may influence egg production are discussed. They include type of blood ingested [*cf.* **23** 27; **26** 43] and fertilisation [*cf.* **44** 184; **46** 151]. Females of a Malayan (Selangor) strain sometimes laid eggs, though usually only a few, without having paired, and were stimulated to oviposit by delayed mating. In a survey of indoor resting places, 58 per cent. of 220 females collected were resting on temporary objects, which are generally not sprayed, 32 per cent. on furniture and 10 per cent. on walls and doors. From a study of the resting population, it is concluded that in nature there is a pre-gravid group [*cf.* **43** 71] of *A. aegypti*, which requires more than one blood-meal for egg development. The size of this group would depend mainly on the conditions in which the larvae developed.

THOMAS (T. C. E.). **A Note on the Occurrence of** *Culex* (*Culex*) *pipiens fatigans* **in Sierra Leone.**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 421–425, 2 graphs, 7 refs. Liverpool, 1956.

Culex pipiens fatigans Wied. was apparently extremely rare in Sierra Leone prior to the second World War, but it comprised 91·6 per cent. of 1,311 mosquitos of the tribe Culicini taken in houses in Freetown between April and August 1955. It is probably responsible for a great rise in the total number of these mosquitos that occurred between 1931 [*cf. R.A.E.*, B **20** 279] and 1947 and is apparently not entirely attributable to improved methods of collection. It may have been introduced as a result of the increased amount of shipping passing through the port of Freetown during the second World War. It has not been found outside Freetown, where it is a characteristically urban mosquito. It breeds in water of high organic content, such as that found in pit latrines and polluted streams, and is highly endophilous and chiefly anthropophilous, though part of the population appears to be unable to feed on man. Egg-rafts were laid 72 hours after the first blood-meal. Autogeny was not observed.

GORDON (R. M.), CREWE (W.) & WILLETT (K. C.). **Studies on the Deposition, Migration, and Development to the Blood Forms of Trypanosomes belonging to the** *Trypanosoma brucei* **Group. I. An Account of the Process of Feeding adopted by the Tsetse-fly when obtaining a Blood-meal from the mammalian Host, with special Reference to the Ejection of Saliva and the Relationship of the Feeding Process to the Deposition of the metacyclic Trypanosomes.**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 426–437, 3 pls., 4 figs., 12 refs. Liverpool, 1956.

An account is given of the apparatus and technique used in observing the process by which *Glossina morsitans* Westw. obtains a blood-meal from the ear of an anaesthetised laboratory mouse [*cf. R.A.E.*, B **46** 126] and also of methods of marking the site of the bite for subsequent indirect observation of the dispersal of the injected saliva by examination of serial sections cut through probed tissues removed from laboratory animals before, during and after the bite of the fly. The processes observed are described. The following is taken from the authors' summary and conclusions. It was found that the tsetse ejects saliva at frequent intervals during the whole process of probing the host's tissues, and that the saliva (and therefore any contained trypanosomes) is widely distributed in the host's tissues throughout the hemisphere within the range of the labium of the feeding fly. Indirect observations suggest that the saliva also seeps through the tissues well beyond the actual injection site. When an adequate blood-supply has been tapped, the tsetse feeds with the labium, and therefore with the contained hypopharynx, in close apposition to the rent in the torn capillary. While taking up its meal from the outpouring stream of blood, it ejects saliva at frequent intervals, and it is reasonable to believe that some of the saliva, together with any contained trypanosomes, will find its way into the lumen of the torn capillary.

HADAWAY (A. B.) & BARLOW (F.). **Effects of Age, Sex and Feeding on the Susceptibility of Mosquitoes to Insecticides.**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 438–443, 7 refs. Liverpool, 1956.

The results are given of tests in which kerosene solutions of recrystallised DDT or dieldrin were applied topically to mosquitos (*Aëdes aegypti* (L.) or *Anopheles stephensi* List.) and LD50's were calculated from the mortalities 48 hours after treatment. The LD50's of DDT in µmg. were 11 and 19 for *stephensi* males and females that were 1–2 days old and had mean weights of 1·11 and 1·50 mg., respectively, and 17–19 for *stephensi* females treated three hours after their first blood-meal or 48 hours after their first, second or third, but increased to 29–32 for those treated 24 hours after their first, second or third blood-meals. The results were similar for *aegypti* females, with LD50's of 15–18 µmg. for those treated before or 3, 48 or 72 hours after their first blood-meal, and 28–30 µmg. for those treated 24 hours after their first, second or third blood-meals. Thus the susceptibility of the mosquitos to DDT did not vary to any great extent with their age but fluctuated regularly through successive feeding cycles.

The LD50's of dieldrin for *aegypti* females exposed before and 3 and 24 hours after their first blood-meal were 39–47, 47 and 78 µmg. and the corresponding figures for *stephensi* females were 17–19, 19 and 30 µmg.

There was no significant difference in susceptibility to DDT between *aegypti* females fed on guineapigs and those fed on man.

CRISP (G.). **Observations on the Distribution and biting Habits of** *Simulium damnosum* **in the Gold Coast.**—*Ann. trop. Med. Parasit.* **50** no. 4 pp. 444–450, 6 maps, 16 refs. Liverpool, 1956.

Six maps of the Gold Coast are given to show the contours, geological formations, annual rainfall, type of vegetation (savannah or closed forest) and density of the human population, and the distributions of *Simulium damnosum* Theo. and (in three categories of severity) of onchocercosis caused by *Onchocerca volvulus*, which occurs wherever the Simuliid is found. *S. damnosum* is present along stretches of all the main rivers in the Northern Territories and also in some tributaries and in streamlets that flow for only a few weeks in the year [*cf. R.A.E.*, B **45** 191], but its distribution outside the Northern Territories is very limited. There is no evidence that the chemical nature of the water or the physical characters of a river, apart from speed and stability of water level, affect its larvae directly, though they may perhaps affect vegetation and predators [*cf.* **46** 124]. It occurs in areas of sedimentary rock as well as on the granite plateau, and geological factors seem to be of importance only in so far as they affect topography. Altitude is of no importance as there are no great heights. There is no evidence that climate has a direct effect, but rainfall has a considerable influence on the type and density of vegetation, which affect the distribution, density and biting habits of the fly [*cf.* **45** 19]. The extent to which the density of *S. damnosum* coming to bite man is representative of the distribution and density of the species is unknown.

LIEUX (D. B.) & MULRENNAN (J. A.). **Investigation of the Biology and Control of Midges in Florida (Diptera: Tendipedidae). A progress Report.**—*Mosq. News* **16** no. 3 pp. 201–204. Albany, N.Y., 1956.

During recent years, Chironomids (Tendipedids) have become an increasingly serious problem in many parts of peninsular Florida. Data on the life-history of *Glyptotendipes paripes* (Edw.), which is the predominant species, are summarised. The larvae develop in U-shaped tubes in the sandy bottoms of lakes, where they are well protected from fish, and feed mainly on plankton. Densities of up to 1,436 larvae per sq. ft. have been recorded in samples from some heavily infested lakes. All instars are present virtually throughout the year, and the larval stage lasts from three weeks to several months. Pupation takes place in the tubes, and the adults emerge at the water surface and fly almost immediately, usually in the early evening or night. They may practically cover the down-wind shore and enter lighted buildings in numbers but do not fly far. They live only a few days.

Thermally produced DDT aerosols or BHC dusts have been used against the adults with varying degrees of success, and light-traps that emit ultra-violet light have protected small areas. Attempts at control have, however, been mainly directed against the larvae, and periodic large-scale applications of larvicides from boats have been made in many lakes since 1953. Only suspensions of wettable powders have been used, as they are thought to constitute less of a hazard to fish than other formulations. BHC at dosages of 0·16–0·2 lb. γ isomer per acre gave spectacular temporary control at first, but the larvae showed considerable resistance to it in all treated lakes after a few months. EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] at 0·1–0·125 lb. active material per acre was used periodically after March 1954 in some 24 lakes, which were treated 1–14 times. Apparent resistance to it was met with in the spring of 1955 in two lakes that had been treated 11 and 13 times. Doubling the usual dosage and applying a combination of BHC and EPN failed to give satisfactory control, though EPN from the same stock gave apparently complete kill applied in two lakes that had received only two and four earlier treatments. Subsequent laboratory comparisons of the effect of EPN on larvae from treated and untreated lakes also indicated physiological resistance. A wide variety of insecticides was then tested, but none proved entirely satisfactory. Other methods of control are being investigated.

Wesley jr. (C.) & Morrill jr. (A. W.). **Air and Insect Penetration of Insect Screens.**—*Mosq. News* **16** no. 3 pp. 204–206, 1 graph. Albany, N.Y., 1956.

Experiments are described in which observations were made on the reduction effected in air flows with original velocities of 5–57 miles per hour by passage through screens of various meshes between 16 × 16 and 24 × 24 per inch. A screen of 18 × 18 mesh reduced air flows of 5 and 8 m.p.h. by 27 and 33 per cent. and air flows of greater velocity by 13–23 per cent. A screen of this mesh, which was the coarsest that was effective in excluding *Aëdes aegypti* (L.), should be fine enough to exclude most insects and would yet allow passage of enough air for pleasant ventilation.

Nowell (W. R.) & Parrish (D. W.). **Effectiveness of a pre-hatching Treatment for the Control of Salt-marsh Mosquitoes in Florida.**—*Mosq. News* **16** no. 3 pp. 212–219, 9 figs., 11 refs. Albany, N.Y., 1956.

The following is based on the authors' summary. In tests carried out in eastern Florida during February and May 1955, BHC (42 per cent. γ isomer), γ BHC (lindane) and dieldrin were applied at 1 lb. per acre as prehatching treatments against the larvae of salt-marsh mosquitos (*Aëdes* *taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.)). Oil solutions of the insecticides were sprayed under pressure from an aircraft equipped with underwing discharge booms. The test plots comprised 267 acres each and were in typical salt-marsh breeding areas. The February treatment was followed by a drought, and no conclusions could be drawn from it. The May treatment was followed by flooding ten and 36 days later, and all the insecticides gave effective control of larvae (about 75 per cent.) after the first flooding. Surveys three days after the second flooding showed about as many larvae in the plots originally treated with the two forms of BHC as in their controls, but the plot treated with dieldrin had only about half as many larvae per dip as its control.

NEWSON (H. D.) & BLAKESLEE (T. E.). **A Study of *Culex tritaeniorhynchus* Oviposition Activity during 1955.**—*Mosq. News* **16** no. 3 pp. 224–228, 2 graphs, 9 refs. Albany, N.Y., 1956.

Culex tritaeniorhynchus Giles, which is known to be naturally infected with the virus of Japanese B encephalitis in Japan [*cf. R.A.E.*, B **40** 163], has not been found there in winter. Female adults have been taken as early as 6th April, and populations increase rapidly to reach a peak in the Tokyo area between 15th July and 7th August, and thereafter decrease sharply until late autumn. Larvae normally persist somewhat later than adults, but both have been collected as late as 15th November. Oviposition activity was studied in the summer and autumn of 1955 by collecting egg-rafts in night-soil tanks in two areas about ten miles apart near Tokyo. Heavy oviposition was in progress when collections were begun in mid-July, and the numbers of egg-rafts continued to be large, with three peaks in one area and two in the other, until 26th September, but were negligible from 28th September to 10th October when the last one was found. Rapid falls in temperature occurred on the night of 25th–26th September, during which the minimum and mean temperatures were 54·1 and 59·4°F., 3° and 2·3° lower, respectively, than any previously recorded during the study, and on the night of 27th–28th, when the mean temperature was 56·2°F. Collections of adults in a light-trap and a cow shed in one of the study areas indicated that the autumn decline in their numbers preceded the decline in numbers of egg-rafts by three weeks.

TAYLOR (R. M.), WORK (T. H.), HURLBUT (H. S.) & RIZK (F.). **A Study of the Ecology of West Nile Virus in Egypt.**—*Amer. J. trop. Med. Hyg.* **5** no. 4 pp. 579–620, 7 figs., 33 refs. Baltimore, Md., 1956.

The following is partly based on the authors' summary. The results are recorded of an investigation of the distribution of West Nile virus in Egypt and the southern Sudan, the epidemiology of human infection in Egypt, and the general ecology of the virus in the Nile Delta, as shown by virus isolations, surveys for specific antibodies and studies of the biological environment in 1951–54 [*cf. R.A.E.*, B **46** 10, etc.]. The serological surveys showed the virus to be widespread in the southern Sudan and along the cultivated part of the Egyptian Nile (but not in the coastal fringe of the delta); neutralising antibodies were found in 61 per cent. of 1,168 samples of human blood collected in Egypt and 40 per cent. of 350 collected in the Sudan. In an endemic area in the Nile Delta in which intensive studies were carried out, West Nile infection was found to be essentially a disease of childhood with yearly peaks of transmission during mid-summer. No reliable information on the symptomatology of the infection in children was obtained, but it appeared to be a self-limited, non-fatal febrile disease rarely associated with definite manifestations of encephalitis. Positive results were obtained in neutralisation tests with all of seven kinds of domestic quadrupeds and four kinds of domestic birds, and with bats and most of the species of wild birds tested [*cf.* **45** 102], but not with rats. The virus was definitely isolated 23 times from febrile children, twice from pigeons (*Columba livia*), once from the hooded crow (*Corvus corone sardonius*), five times from *Culex antennatus* (Becker), nine times from *C. univittatus* Theo., and three times from pools of mosquitos consisting mainly of *C. univittatus*, and probable isolations, not confirmed by reinoculation of the mosquito suspensions, comprised three from *C. univittatus*, one from *C. pipiens* L., and one from *Anopheles pharoensis* Theo. The fact that *C. univittatus* was more often found to be infected than any other mosquito may be due to its relative predilection for avian blood. None of over 26,000 examples of other arthropods yielded the virus.

It is concluded, on both experimental and ecological grounds, that the main cycle of the virus is through mosquitos and birds, and that man may be involved in this cycle incidentally. The infections in domestic quadrupeds are probably inadequate to infect mosquitos [*cf.* **45** 102]. It is likely that non-migratory birds are responsible for the local dissemination of the virus; the possibility that it is transported over long distances by migratory birds was not investigated. The finding of occasional cases of recently acquired immunity in children in spring, coupled with the fact that certain mosquitos, including *C. pipiens* [*cf.* **41** 207], are active throughout the year, indicates that the virus overwinters by means of retarded transmission by such mosquitos, although *C. pipiens* in this area rarely feeds on birds and most of the human population is immune. The pool of *C. pipiens* from which the virus was probably isolated comprised 14 females taken in bedrooms in January 1954, whereas all the other definitely or probably infected mosquitos were collected in July–September. The fact that the disease is not endemic in the northern rim of the delta may be accounted for by the less dense human and bird population there and the scarcity of *C. univittatus*, which appears to be the most important vector.

ANDERSON (C. R.), AITKEN (T. H. G.) & DOWNS (W. G.). **The Isolation of Ilhéus Virus from wild caught Forest Mosquitoes in Trinidad.**—*Amer. J. trop. Med. Hyg.* **5** no. 4 pp. 621–625. 5 refs. Baltimore, Md., 1956.

Two strains of virus isolated in mice from forest mosquitos collected in Trinidad in 1954 were identified by reciprocal cross-neutralisation tests as the virus of Ilhéus encephalitis, which had not been found in nature since its original isolation from mosquitos in Brazil [*R.A.E.*, B **38** 107]. Both produced a haemagglutinating antigen similar in reactivity to the antigen produced from the known Ilhéus strain. The isolations in Trinidad were made during investigations undertaken as a result of the finding of neutralising antibodies to Ilhéus virus in a high percentage of human sera collected from certain parts of the island in immunity surveys. The first strain was isolated from a collection of 75 mosquitos of 14 species belonging to eight genera (including large numbers of *Psorophora* and *Aëdes*) and the second from a collection of 143 mosquitos belonging to three species of *Psorophora*. The two batches of mosquitos were taken 22 miles apart.

The isolation of four more strains of Ilhéus virus from Trinidad mosquitos in 1955 and 1956 is announced in an addendum. One of the strains was from a pool of seven females of *Psorophora ferox* (Humboldt). The other three were from pools of mixed mosquitos of 7–9 genera. Two of the pools included reasonably large numbers of *Aëdes* and *Psorophora* but the third had only 30 individuals of *Aëdes* (*serratus* (Theo.)) and one of *Psorophora* (*lutzii* (Theo.)).

HARMSTON (F. C.), SHULTZ (G. R.), EADS (R. B.) & MENZIES (G. C.). **Mosquitoes and Encephalitis in the irrigated High Plains of Texas.**—*Publ. Hlth Rep.* **71** no. 8 pp. 759–766, 5 figs., 7 refs. Washington, D. C., 1956.

The possible relationship between the expansion of irrigation and the increase in encephalitis in man in the High Plains of north-western Texas was investigated in 1953–54. The Plains occupy an area of about 20,000 sq. miles and are flat or gently undulating. Irrigated cropland increased from 250,000 acres in 1940 to 1,860,000 acres in 1950. Deep wells are the chief source of irrigation water, but the effluent from sewage treatment plants is used in some localities. Cases of human and equine encephalitis were reported from the irrigated sections during most years in the period 1940–54, with as many as 16 reported human cases in 1944 and 23, 11 and 32 in 1952, 1953 and 1954. The reported equine cases ranged from three in 1942 to 26 in 1944, with 25 in 1952.

Preliminary surveys in 1953 indicated that mosquito problems of public-health significance occurred in the Plains and were related to agricultural and municipal use and disposal of water. Detailed studies in representative areas during 1954 showed that *Culex tarsalis* Coq., the principal vector of the western equine virus, was abundant from early June to the end of September. It comprised 50 and 24 per cent. of the female mosquitos taken in light-traps in urban and rural sites, and was the most abundant species in larval collections. In collections of mosquitos biting man in the evening, it was the second most abundant species in a town and the third in surrounding rural areas. *C. pipiens fatigans* Wied. (*quinquefasciatus*, auct.), which was abundant during the latter part of the season in both urban and rural areas, ranked third in the urban and sixth in the rural light-trap collections. The virus of western equine encephalitis was isolated from three out of 15 pools of *C. tarsalis*, comprising 1,315 females, and from one out of 17 pools of *C. p. fatigans*, comprising 3,324 females. *Aëdes nigromaculis* (Ludl.) and *A. vexans* (Mg.) ranked first and fifth in the total number of females taken in the light-traps, first and second in the rural biting collections, and third and first in the urban biting collections. Both are experimental vectors of the western equine virus [*R.A.E.*, B **23** 197; **44** 40] and have been found infected in nature [*cf.* **43** 176].

Playa lakes on grazing land (undrained natural depressions usually dry during winter and flooded during the growing season by surface run-off and irrigation waste) were responsible for about three-quarters of the mosquito production in both of the two principal study areas, and surface pools and roadside ditches and borrow pits for almost all of the remainder. Waste and residual irrigation water, including residual sewage effluent on pasture, accounted for 87 and 45 per cent. of the production in the two areas and surface run-off from local rain for practically all the rest. *C. tarsalis* was found in all types of breeding places except irrigation laterals and was predominant in the playa lakes, surface pools on pasture irrigated with sewage effluent and the edges of a sewage-polluted creek. *A. nigromaculis* was common in all habitats except the edges of the sewage-polluted creek.

Water-conservation measures are needed throughout the High Plains and could probably be designed to serve mosquito control as well as agriculture. Breeding places associated with municipal sewage disposal were of local importance, particularly as a source of *C. p. fatigans* and *C. tarsalis*; they included a playa used as a sewage lagoon and kept in a marshy condition through the diversion of effluent for irrigation and parts of oxidation ponds with dense vegetation.

Kilpatrick (J. W.) & Schoof (H. F.). **Fly Production in treated and untreated Privies.**—*Publ. Hlth Rep.* **71** no. 8 pp. 787–796, 3 figs., 6 graphs, 2 refs. Washington, D. C., 1956.

Field observations having indicated that dieldrin increases breeding by house-flies (*Musca domestica* L.) in human faeces [*R.A.E.*, B **44** 30; **46** 57], studies were made in Georgia in 1954 to determine the effect on production of *M. domestica* and other flies of treatment of privies with dieldrin, DDT, BHC, chlordane and aldrin at rates of 50, 200, 40, 100 and 50 mg. per sq. ft., respectively. In the first series of tests, 30 privies and all animal pens and porches on the same premises were treated with dieldrin and 10 with DDT, while 20 were kept as untreated controls. The privy treatments included the pits and their contents. To estimate the results, the privies were divided into two similar groups, which were alternately opened to fly breeding and sealed so that all emerging flies could be trapped, in three-week cycles. Within four weeks, the dieldrin-treated privies showed a sharp increase in house-fly production. The average numbers of adults of *M. domestica* and (in brackets) flies of all species emerging in the successive months from April to September were 20 (792), 193 (510), 254 (744), 1,374 (1,903), 1,204 (1,369) and 1,946 (2,584), as compared with 1 (494), 15 (630), 7 (269), 103 (348), 14 (107) and 36 (226) for the DDT-treated privies, and 1 (1,019), 3 (468), 13 (352), 5 (151), 16 (96) and 10 (135) for the controls. Great increases in the production of *M. domestica* in other privies resulted from August treatment of the pit contents, riser walls inside and outside and the inside of the superstructure with BHC, dieldrin or chlordane, and from September treatment of inside walls of the structures and pits and their contents with aldrin and of the riser walls only or the pit contents only with dieldrin.

Larvae of *Hermetia illucens* (L.) were observed to be prevalent in untreated privies and scarce in dieldrin-treated ones, but laboratory cultures in which they were reared with larvae of *M. domestica* failed to yield any evidence of detrimental effect on either from the presence of the other [**46** 131]. It is concluded that the small numbers of house-flies produced in untreated privies and much larger numbers produced in privies treated with BHC, chlordane, aldrin and dieldrin indicate that these insecticides should not be used for privy treatment.

Emerson (K. C.). **A new Species of Mallophaga from the Pigeon.**—*Florida Ent.* **40** no. 2 pp. 63–64, 3 figs., 2 refs. Gainesville, Fla., 1957.

Adults of both sexes of *Bonomiella columbae*, sp. n., which was found in small numbers on domestic pigeons in Kansas and British Columbia, are figured and briefly described, and a key to the species of Mallophaga that infest domestic pigeons is given.

Lancaster jr. (J. L.). **Preliminary Studies of granular Insecticides against the Lone Star Tick.**—*J. Kans. ent. Soc.* **30** no. 2 pp. 41–42, 5 refs. Manhattan, Kans., 1957.

Application of acaricides to the ground cover has long been known to be effective against ticks [*R.A.E.*, B **32** 199; **35** 24; **39** 60; *cf.* also **46** 89, etc.].

but ground machinery cannot be used in wooded areas without roads, and dusts or sprays applied from aircraft would be deposited on the upper foliage. Granules, however, would be likely to reach the ground, and the effectiveness of dieldrin, heptachlor and chlordane in granular form was therefore tested in Arkansas on greenhouse plots covered with oat plants, to which they were applied on 18th October 1955 at rates equivalent to 1 lb. dieldrin or heptachlor or 2 lb. chlordane per acre. All treatments gave complete kill in a week of ticks [*Amblyomma americanum* (L.)] put on the treated plots next day, whereas there was no mortality in a control plot, and dieldrin gave complete kill, much of it within five days in most months, of ticks put on the plots in February, March, April and May 1956 and complete kill in 12 days of ticks put on in October. Heptachlor and chlordane gave no kill in February and the plots treated with them were not subsequently tested. The plots were watered regularly from October to May but not during the summer.

Quan (S. F.), Kartman (L.) & McManus (A. G.). **Studies on** *Pasteurella pestis* **in Fleas: II. Experimental Blocking of** *Xenopsylla cheopis* **with an Avirulent Strain of** *P. pestis*.—*Science* **120** no. 3131 pp. 1101–1102, 1 graph, 14 refs. Lancaster, Pa., 1954.

Kartman (L.), Prince (F. M.) & Quan (S. F.). [**III.**] **Comparative Plague-Vector Efficiency of** *Xenopsylla vexabilis hawaiiensis* **and** *Xenopsylla cheopis*.—*Bull. World Hlth Org.* **14** no. 4 pp. 681–704, 6 figs., 5 graphs, 28 refs. Geneva, 1956. (With a Summary in French.)

Kartman (L.), Quan (S. F.) & McManus (A. G.). **IV. Experimental Blocking of** *Xenopsylla vexabilis hawaiiensis* **and** *Xenopsylla cheopis* **with an Avirulent Strain.**—*Exp. Parasit.* **5** no. 5 pp. 435–440, 2 graphs, 5 refs. New York, N. Y., 1956.

These papers are the second, third and fourth of a series in the first of which the development of an apparatus for the artificial feeding of fleas was described [*R.A.E.*, B **43** 161]. It was used in the experiments recorded in the second paper for the quantitative transfer of an avirulent strain of *Pasteurella pestis* to fleas (*Xenopsylla cheopis* (Roths.)), which were subsequently maintained on white rats. The bacilli multiplied rapidly in the ventriculus after the first day. The minimum concentration of bacilli necessary to infect the fleas was much higher than the 10,000 per ml., estimated to be needed with a virulent strain. In an early test, all fleas given a blood-meal containing 400 million bacilli per ml. became infected initially, but only two out of 32 remained so after five days, whereas more than 80 per cent. remained infected after this period when the blood-meal had contained 720 million bacilli or more per ml. Definite proventricular blocks, associated with empty and constricted stomachs, occurred as early as the second day after the infective meal, but the rate of blocking did not attain 30–40 per cent. until after 6–9 days. Typical ventricular plague masses were seen on the third day and were found in more than half of the fleas examined from the fifth day onwards. As expected, the strain was still completely avirulent after one passage in the fleas, and the rats on which they fed showed no symptoms of plague.

An account is given in the third paper of a comparative study of the effectiveness as plague vectors of *X. vexabilis hawaiiensis* Jordan and *X. cheopis* when both were infected with a virulent Hawaiian strain. Infective and test feeds were all on mice, and the strain of *X. cheopis* used was from

California. To derive numerical values for vector efficiency, the concepts of Wheeler & Douglas (infection potential, vector potential and transmission potential) [**30** 33] were used with some modifications. The infection potential was based on the percentage of fleas proved to be infected after their death, as the criterion of infected faeces was found to be unreliable [*cf.* **32** 108], and the vector potential was termed the blocking potential and was based on the percentage of fleas with permanent proventricular blocks. An additional component, the blocking-survival potential, was also used. This is the ratio of the mean day of death of fleas after blocking to the mean day of blocking after the infective meal. The product of the four potentials constitutes the vector index. The figures for vector efficiency and (in brackets) vector index of males and females were 0·57 (0·11) and 0·99 (0·09) for *X. cheopis*, and 0·3 (0·07) and 0·35 (0·05) for *X. v. hawaiiensis.* Females of *X. cheopis* took longer to become blocked than males and survived for a shorter time after blocking. *X. v. hawaiiensis* became blocked sooner than *X. cheopis*, but a very slightly higher proportion of the latter became blocked. The observed values for vector efficiency and index both indicated that *X. cheopis* was about twice as effective in transmission as *X. v. hawaiiensis.* However, the latter is probably responsible for maintaining plague in rodents in Hamakua District, the enzootic region of the Island of Hawaii, as it is the predominant flea on field rats, including *Rattus hawaiiensis*, which is thought to be essential to the maintenance of plague there. It is possible that the strain of *X. cheopis* used and the Hamakua strain differ in vector efficiency.

The experiment described in the fourth paper indicated that there were no major differences in the ability of the avirulent strain of *P. pestis* to produce proventricular blocks in males of *X. cheopis* and males and females of *X. vexabilis hawaiiensis.* The fleas were fed separately on infective suspensions in the feeding apparatus and then maintained separately on young rats. The blocking rates in males of *X. v. hawaiiensis* and *X. cheopis* increased very rapidly after five and ten days, respectively, whereas the rate in females of the former rose gradually and over a longer period, and this was probably the reason why the males suffered such high mortality that the percentages recovered after 15–20 days were less than half the percentage of females recovered after 30 days.

Brown (A. W. A.). **DDT-Dehydrochlorinase Activity in resistant House-flies and Mosquitos.**—*Bull. World Hlth Org.* **14** no. 4 pp. 807–812. 5 refs. Geneva, 1956.

An account is given of the technique and results of investigations in which the author demonstrated the activity of DDT-dehydrochlorinase in homogenates and acetone powders of two strains of house-flies [*Musca domestica* L.] but failed to demonstrate it in similar preparations of fourth-instar larvae of DDT-resistant strains of *Aëdes aegypti* (L.) and salt-marsh mosquitos (a mixture of *A. taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.)), although it was evident in the living larvae. One of the strains of *M. domestica* (DDT-45) had been exposed to DDT for six years and the other (Dilan) had been exposed to Dilan [a mixture of 1,1-bis(p-chlorophenyl)-2-nitrobutane and 1,1-bis(p-chlorophenyl)-2-nitropropane] for two years but had never been exposed to DDT. Both showed an LD50 of more than 50 μg. per fly when DDT was applied topically. The average amounts of DDE [1,1-bis(p-chlorophenyl)-2,2-dichloroethylene] produced in three hours from 200 μg. DDT by homogenates equivalent to six flies were 98 and 100 μg. for the DDT-45 and Dilan strains, respectively. The corresponding amounts for acetone powders equivalent to 37 flies were 64 and 30 μg. when the powders were fresh, and 52 and 39 μg. when they were two weeks old. The larvae of the resistant strain of salt-marsh mosquitos were obtained from Florida and were compared with susceptible larvae from Georgia. The LC50's of DDT, with 24 hours' exposure were 0·04 and 0·003 p.p.m., respectively, and the 140 larvae of the Florida strain used for the toxicity test were found to contain 73·3 μg. DDT and 15·9 μg. DDE. The LC50's of DDT for the resistant strain of *A. aegypti* (from Trinidad [*cf.* **46** 108–109]) and a normal strain from Maryland were 2 and 0·004 p.p.m., respectively, and 150 larvae of the Trinidad strain exposed to 1 p.p.m. for 24 hours contained 1,553 μg. DDT and 149·3 μg. DDE. This is a rate of DDE production of the same order as that found in resistant house-flies. Despite this, no DDE was produced by homogenates or acetone powders of the resistant larvae of *A. aegypti*, and no significant amount by homogenates of the salt-marsh larvae. This suggests that the conditions needed by the dehydrochlorinase from resistant mosquitos must be different from those needed by this enzyme from resistant house-flies.

SCHROEDER (H. O.) & JONES (H. A.). **Household Aerosol Insecticides. How do they fare against House Flies resistant to chlorinated Pesticides?** —*Soap & chem. Spec.* **33** no. 12 pp. 115, 117, 121, 123, 265, 2 figs., 7 refs. New York, N. Y., 1957.

Although there is evidence that house-flies [*Musca domestica* L.] have developed resistance to one or more insecticides throughout the United States, household sprays and aerosols for fly control, which are required to meet certain minimum standards of performance, are still tested against laboratory strains carefully protected to ensure normal susceptibility. Because of this situation, the effectiveness of typical liquefied-gas aerosol formulations was tested against flies of a resistant strain. The Official CSMA method for testing aerosols against flying insects [*R.A.E.*, B **44** 25, etc.] was used, and the test insects were of a strain (Fowler) occurring naturally on an experimental farm in Illinois. The OTA (2 per cent. DDT and 0·4 per cent. pyrethrins) was tested at the standard dosage of 3 g. per 1,000 cu. ft. [**40** 15] against both Fowler and normally susceptible flies in practically every series of tests. It never gave less than 72 per cent. mortality of the latter in 24 hours or more than 21 per cent. of the former. Formulations containing 2 per cent. DDT or 3 per cent. methoxy-DDT (methoxychlor) with minimum amounts of knockdown agents gave only 6 per cent. kill of Fowler flies at the standard dosage and 25–47 per cent. at dosages of 8–9 g. One of the aerosols containing 3 per cent. methoxy-DDT gave 71 per cent. kill when the dosage was increased to 12 g., but even a mixture containing both 3 per cent. DDT and 1 per cent. methoxy-DDT killed only 42 per cent. at a dosage of 8 g. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of approximately 66 per cent.], ethyl-DDD (Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane]) and DDT at 2 per cent. and methoxy-DDT at 3 per cent. were compared in aerosols also containing 0·2 per cent. pyrethrins and 0·5 per cent. piperonyl butoxide and gave 61, 45, 38 and 47 per cent. kill, respectively, of the Fowler strain. On the other hand, formulations containing pyrethrins and piperonyl butoxide as the only active ingredients gave good results against Fowler flies at concentrations that gave good results against normal flies; one containing 0·25 per cent. pyrethrins and 1 per cent. piperonyl butoxide gave 80 per cent. kill of the former and was not improved by the addition of 2 per cent. methoxy-DDT.

Abbott (D. C.). Johnson (E. I.) & Polhill (R. D. A.). **The Determination of the γ-isomer of Benzene Hexachloride in Sheep Dips and similar Formulations.**—*J. Sci. Fd Agric.* **9** no. 5 pp. 308–312, 12 refs. London, 1958.

The following is the authors' summary of this account of methods that have been used to determine γ BHC in concentrates for sheep dips of the emulsion or suspension types and have proved successful even for a formulation containing ten times as much heavy oil as BHC. Benzene hexachloride may be separated from mixtures with most other substances by treatment with fuming sulphuric acid on a kieselguhr column. A method employing this device for the determination of γ-isomer in complex formulations and a method of making the nitromethane-silica partition chromatographic column from readily available materials are described.

Brundrett (H. M.). McGregor (W. S.) & Bushland (R. C.). **Systemic Cattle Grub Control with Bayer 21/199 Sprays.**—*Agric. Chem.* **12** no. 6 pp. 36–37, 123, 125, 9 refs. Baltimore, Md., 1957.

As Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate] had shown promise for the control of *Hypoderma* larvae when used as a wash [*R.A.E.*, B **43** 118] or spray [**44** 56], it was further tested as a spray in Texas in 1955 and 1956. The tests in 1955 were made on cattle infested with second- and third-instar larvae of *H. lineatum* (Vill.), which are in the backs in late summer and autumn in Texas. A 0·75 per cent. emulsified solution applied on 31st August at a pressure of 250 lb. and a rate of 2 U.S. quarts per animal, a dosage shown by R. D. Radeleff & G. T. Woodard to be well tolerated by grown cattle and calves more than two months old, killed 95 per cent. of the 146 larvae present, and a 0·25 per cent. emulsified solution applied on 5th October killed 94 per cent. of 155 larvae. New larvae encysted and grew normally in the cattle receiving the weaker spray, but none appeared in the backs of those receiving the stronger one, indicating a systemic action that killed the young larvae before they had encysted [*cf.* **46** 54].

The systemic effect of sprays containing 0·75 per cent. Bayer 21/199 was further tested in 1956 and compared with that of sprays containing 1 per cent. Dow ET-57 [purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate], which had shown special promise when given orally [**46** 54, 89]. Both insecticides were used as emulsified solutions and as wettable-powder suspensions. Calves about eight months old that had been born and kept in the same pasture were divided into four test groups of seven each and one group of 11 controls, and the test groups were treated on 25th July with sprays applied at a pressure of 100 lb. ET-57 was applied at 100 mg. per kg., as this had been found an effective oral dosage, and 21/199 at 75 mg. The calves were examined monthly for the next seven months. Both formulations of 21/199 almost entirely prevented larvae from encysting; one calf had three larvae, three had one each, and the other ten had none. The calves treated with ET-57 had 10–42 larvae with an average of 26·9 at the count at which they were most heavily infested, and the controls had 20–60 with an average of 37·2; the numbers of calves were too small to determine whether the difference was significant.

Burnett (G. F.). **The Relation between Age and Cold Resistance in Tsetse Flies and the Value of Chilling when transporting Tsetse for Experiments.**—*Proc. R. ent. Soc. Lond.* (A) **32** pt. 4–6 pp. 53–58, 8 refs. London, 1957.

Experiments are described that confirm a theory that observed irregularity in the susceptibility to low temperatures of individuals of a species of *Glossina* is attributable to an increase in susceptibility with age. The theory was based on an experiment at Urambo, Tanganyika, in which adults of *G. morsitans* Westw. were caught, chilled to immobility at a temperature just above freezing, marked, released and recaptured. They recovered their mobility on being warmed, but there was sometimes appreciable mortality in the release cage, and recapture data indicated considerable delayed mortality also. There was no significant difference in the recaptures of males in different hunger states [*R.A.E.*, B **22** 25] or between males and females, but 40 per cent. of the teneral flies and only 20 per cent. of the non-teneral flies were recaptured in the first four days. It appeared that this might be due either to the superior resistance to cold of the young flies or to the fact that they had not fed [*cf.* **21** 202]. Vanderplank also observed delayed mortality with adults of several species, including *G. palpalis fuscipes* Newst. and *G. morsitans*, all of which recovered after they had been kept at 0°C. [32°F.] but could not feed, even if they had been chilled for only a few minutes.

The first tests were made with adults of *G. p. fuscipes* that had emerged from pupae collected in Uganda near Lake Victoria. They were offered a blood-meal on a rabbit every day and exposed at different ages to temperatures falling to 1·2–9°C. [34·16–48·2°F.]. There was no marked difference in the resistance of the sexes to the immediate effects of cooling, but subsequent mortality seemed to be slightly higher in males. Resistance to cold was lost progressively and rapidly with increasing age in both sexes. The viability of teneral flies was unaffected by the most rigorous treatment used (chilling for three hours with a minimum temperature of 1·2°C.), but 58 per cent. of the flies seven days old died within two days and 63 per cent. of flies ten days old within one day of chilling for three hours with a minimum temperature of 2°C. [35·6°F.] and all flies two weeks old died in one day after chilling for only one hour with the same minimum. The mildest treatment, 9–10°C. [48·2–50°F.] for 3–4 hours, was completely harmless to flies 16 days old, though it appeared possibly to have reduced the viability of those five days old. The tests showed that it is possible for flies that have fed to escape immediate or even delayed death after cooling for three hours with a minimum temperature of 2°C. and also to feed safely after cooling.

Further experiments were made with non-teneral flies collected in woodland in Tanganyika. They were kept in tubes at 10°C. until they were cooled and released at dusk after the appropriate exposure into a large cage suspended in a room. At dawn, those that were dead or unable to fly were removed and the others collected and killed. In the tests with males of *G. morsitans*, mortality percentages increased both with depression of temperature and time of exposure. They were 9 and 25 after exposure to 10°C. for three and six hours, and 42, 75 and 80 after exposure to 2°C., for ten minutes and one and two hours, respectively. In tests with much smaller numbers of flies, mortality of females of *G. morsitans* was sometimes rather less and sometimes a little more than that of the males, and males of *G. swynnertoni* Aust. were consistently more susceptible. For the most severe treatments with the *morsitans* males (one and two hours at 2°C.), the mean age of dead flies (calculated from wing fray) was 33 days and of survivors 18 days. This was the only instance in which increase of susceptibility with age was statistically significant, but the trend was constant.

It is remarkable that mortality was appreciable, even at temperatures frequently met with at some seasons in tsetse habitats. As it is the older, breeding section of the population that succumbs, cold may be an important factor in limiting distribution by killing flies as well as by retarding development. Moreover, even moderate chilling to facilitate handling of flies for release may be undesirable. In a field experiment in which recaptures of flies cooled to 8–10°C. and to 2–3°C. were compared with recaptures of flies marked and released immediately after capture in an earlier year at the same season and place, recaptures of both sets of chilled flies were depressed in the first four days after release. In the fourth week, recaptures of flies chilled to 8–10 and 2–3°C. were only half and one-sixth of those of unchilled flies after due allowance for pre-release deaths.

WEITZ (B.) & GLASGOW (J. P.). **The natural Hosts of some Species of *Glossina* in East Africa.**—*Trans. R. Soc. trop. Med. Hyg.* **50** no. 6 pp. 593–612, 19 refs. London, 1956.

The following is virtually the authors' summary. The natural hosts of seven species of *Glossina* were studied by the identification of 1,433 blood-meals of flies caught in different areas. The identification was made by the combination of the precipitin test and the inhibition of agglutination test, which gave specific and reliable results. A significant preference for Suid blood was observed with *G. morsitans* Westw. [*cf. R.A.E.*, B **44** 3], *G. swynnertoni* Aust. and *G. austeni* Newst. [*cf.* **44** 92], which derived nearly or more than half their food supply from pigs, mainly wart-hog (*Phacochoerus aethiopicus*) in the case of the first two and bush-pig (*Potamochoerus*) in the case of the third. No flies fed on zebra, hartebeest (*Alcelaphus*) or topi (*Damaliscus*), and only very few feeds were found from impala (*Aepyceros melampus*), which was very numerous in some areas. *G. palpalis fuscipes* Newst. fed mainly on reptiles in one area, but a large proportion of feeds were of avian origin in another. Bushbuck (*Tragelaphus*) formed the greater part of the food of *G. pallidipes* Aust. *G. brevipalpis* Newst. fed chiefly on hippopotamus in an area from which the game had been partly eliminated. A few feeds of *G. longipennis* Corti were all from rhinoceros.

MORRISON (F. O.). **The Ratio of the Width to the Length of the second abdominal Sternite of the House Fly.**—*J. econ. Ent.* **50** no. 5 pp. 554–556, 3 refs. Menasha, Wis., 1957.

The following is virtually the author's summary. Measurements were made of the ratio (designated X_5) of the width to the length of the second abdominal sternite of adult house-flies [*Musca domestica* L.] of both sexes from 19 different cultures being reared in a number of widely separated insecticide testing laboratories [*cf. R.A.E.*, B **43** 164]. This ratio varied from culture to culture, and large ratios were in general associated with cultures said to be DDT-resistant and small ratios with cultures said to be susceptible, but the correlation was not perfect. Differences due to measurement of samples of the same culture by different workers were not significant. Differences between samples drawn from the same cultures at long time intervals were significant in one instance but not in another. Cultures with a known common origin in the past showed ratios with a narrow range. The ratios differed for the different sexes of the same strain in seven of the 19 cultures.

COLE (M. M.), COUCH (M. D.), BURDEN (G. S.) & GILBERT (I. H.). **Further Studies on Resistance of Human Body Lice to Insecticides.**—*J. econ. Ent.* **50** no. 5 pp. 556–559, 5 refs. Menasha, Wis., 1957.

The results are given of further laboratory studies on the development and nature of resistance to various insecticides in *Pediculus humanus*

humanus L. [*cf. R.A.E.*, B **44** 18]. A strain of lice from Korea that had developed extreme resistance to DDT during exposure for 15 generations on cloth impregnated with a 0·01 per cent. solution was maintained in the same way for 70 generations, and its susceptibility to 11 analogues was then compared with that of a normal strain. It was more resistant to five analogues, including Prolan (1,1-bis(p-chlorophenyl)-2-nitropropane), but not to four others, while two, dianisyl neopentane [1,1-bis(p-methoxyphenyl)-2,2,2-trimethylethane] and MR-60 (bis(p-chlorophenyl)chloromethane), were not effective against either strain. A subcolony that had lost some resistance after being reared on untreated cloth for 15 generations [*loc. cit.*], lost no more by the 45th generation. MR-60 and DMC [di(p-chlorophenyl)methylcarbinol], which increase the effectiveness of DDT against resistant house-flies [**41** 74; **45** 171], failed to increase it against the highly resistant strain, the subcolony or a non-resistant strain of lice. In view of this, as well as the resistance to Prolan of the DDT-resistant lice and Busvine's findings with dianisyl neopentane [**41** 159], it appears that dehydrochlorination is not the important mechanism of DDT-resistance in body lice.

A colony of lice maintained for 26 generations on cloth treated with 0·0001 per cent. DDT solution failed to develop more than twofold resistance. Mortality in the colony did not exceed that on untreated cloth. Colonies of lice reared for 13–35 generations on cloth treated with low concentrations of γ BHC (lindane), Lauseto neu [p-chlorophenyl chloromethyl sulphone], Strobane [a chlorinated mixture of α-pinene isomers] and pyrethrins plus sulfoxide [n-octyl sulphoxide of isosafrole] developed less than twofold resistance to these insecticides.

Jarvis jr. (F. E.) & Grayson (J. M.). **Residual Effectiveness of Insecticide Formulations in killing resistant and non-resistant German Cockroaches.**—*J. econ. Ent.* **50** no. 5 pp. 604–605, 2 refs. Menasha, Wis., 1957.

The effectiveness against German cockroaches [*Blattella germanica* (L.)] of a chlordane-resistant and a non-resistant strain of 16 insecticidal formulations applied to tempered masonite panels was determined by dipping the panels, hanging them in a building until the deposits had aged for 21, 30 and 60 days, and then exposing adult females to them. Six of the formulations were further tested on panels of wood and galvanised sheet metal after the deposits had aged for 21 and 30 days. The results for the wood and metal panels and for the masonite panels aged for 21 and 60 days are given in a table that shows the percentages of the cockroaches dead after exposure for one, three and six days. The most effective formulation was 2 per cent. Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate] in emulsified solution, which gave complete kill of both strains at both ages on all surfaces in one day. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] in a 0·5 per cent. emulsion gave complete kill in three days on masonite and wood but very poor results on metal. Several formulations containing 2 per cent. malathion, with or without allethrin, gave complete kill in six days, and some of them in three, and 4 per cent. Malrin [1·8 per cent. malathion and 3·6 per cent. ethyl-DDD (1,1-bis (p-ethylphenyl)-2,2-dichloroethane)] gave 99–100 per cent. kill on masonite in six days. Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] at 1 per cent. was more effective on masonite in oil than in water solution, but in both cases, kill was considerably less after aging for 60 days than for 21. Chlordane at 2 per cent. and dieldrin at 0·5 per cent. gave poor kills, and 0·1 per cent. allethrin was ineffective on masonite. Dipterex, Malrin and allethrin were not tested on wood or metal.

Wilson (H. G.) & Gahan (J. B.). **Control of House Fly Larvae in Poultry Houses.**—*J. econ. Ent.* **50** no. 5 pp. 613–614, 7 refs. Menasha, Wis., 1957.

In many parts of the United States, fowls are kept in rows of cages about 3 ft. above the ground, and their droppings are allowed to accumulate under the cages, where they form cones of manure sometimes 2–3 ft. high. This manure is not an important source of flies if it remains dry, but larvae of *Musca domestica* L. and *Hermetia illucens* (L.) develop in it in great numbers if it becomes moist or wet, and eight phosphorus compounds were tested in Florida against natural populations of larvae of *M. domestica* in it [*cf. R.A.E.*, B **45** 178–179]. They comprised Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] as a solution in water, and diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], Bayer 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate], Dow ET-14 (O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate), Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate], malathion, Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] and parathion in emulsions, and all were applied with a watering can at rates of 50–100 ml. liquid per sq. ft. The percentages of control given after two days and (in brackets) one week by five of the compounds at a dilution to give 100 mg. per sq. ft. were 84 (100) by Diazinon, 99 (100) in one test and 100 (5) in another by Dipterex, 100 (0) by Bayer 21/199, 72 (100) by Dow ET-14, and 96 (73) in one test and 0 (0) in another by malathion. Heavier dosages were no more effective. Am. Cyanamid 4124 at 200 mg. per sq. ft. gave 97 (77) per cent. control, and Chlorthion at the same rate gave 96 (9) per cent. in one test and no control in another. Parathion at 100 and 200 mg. gave no control. Diazinon was the only compound that showed appreciable effectiveness after two weeks [*cf.* **46** 142], giving 96 per cent. control at 100 mg. and 58 per cent. at 200 mg.

As the treatments increased the fluidity of the manure, making it unfit for sale and difficult to handle, Diazinon was further tested as a dust. A mixture of 1·86 lb. 25 per cent. Diazinon wettable powder, 36 lb. attapulgite and 2 lb. celite was sprinkled at 150 mg. Diazinon per sq. ft. on 13th June 1956 on to wet manure containing large numbers of larvae of *M. domestica* and *H. illucens*. Two days later only one *Hermetia* larva was found. A second application was made on 20th June, when the manure was still wet and a few *Musca* larvae were present. Two days later, only one *Hermetia* larva was found, but a few *Musca* were present on 5th July. The manure was removed about four days later, when it was still soft but much improved. On 13th July, weekly treatments were begun on freshly stacked manure on the same farm. Numerous *Musca* larvae were found before treatment, but all were dead after 48 hours. Very few were found from 18th July to the end of September, except during one week when a defective powder was used. On 7th November, a single application was made on another farm to manure heavily infested with both species. Control in 24 hours was estimated at 95 per cent., and no larvae could be found 1–2 weeks later, a few were present in the third week and reinfestation was general in the fourth.

DeFoliart (G. R.). **Lice Control on Northern Range Herds with residual Sprays.**—*J. econ. Ent.* **50** no. 5 pp. 618–621, 9 refs. Menasha, Wis., 1957.

The duration of effectiveness of single applications of chlordane, heptachlor, dieldrin, lindane (γ BHC), ethyl-DDD (Perthane [1,1-bis (p-ethylphenyl)-2,2-dichloroethane]), DDT or malathion to range beef cattle for the control of lice was investigated in 1951–56 when herds were observed for up to six months after treatment with wettable-powder suspensions. The work was carried out in south-eastern Wyoming, and *Solenopotes capillatus* End. was the most abundant louse. *Linognathus vituli* (L.) was second in importance, and *Haematopinus eurysternus* (Nitzsch) and *Damalinia bovis* (L.) were seen occasionally. Sprays were applied at a pressure of 200–400 lb. per sq. inch and at rates varying from less than two to more than three U.S. gals. per animal, according to age and season. Chlordane, malathion and DDT at 0·5 per cent., heptachlor at 0·06 per cent. and dieldrin at 0·03 per cent. were about equal in effectiveness, generally providing satisfactory control for 4–5 months. This does not represent full seasonal control in Wyoming, where the climate is conducive to heavy infestation for 7–8 months. Ethyl-DDD at 0·5 per cent. was the least effective insecticide and lindane at 0·025–0·046 per cent. was inferior to the others.

BHC (technical) is widely used for louse control by ranchers because of its low cost, and except for dieldrin, which is unlikely to be used on cattle, heptachlor is the only insecticide tested that could compete with it on a cost basis. Combining chlordane with BHC, lindane or malathion did not prolong control. Chlordane, dieldrin and lindane were not ovicidal under field conditions, but 0·025 per cent. lindane killed all nymphs after the operculum was lifted and before they could extricate themselves from the shell. BHC at a concentration giving the same amount of γ isomer in the spray killed 93 per cent. Malathion at 0·25 per cent. produced 52 per cent. mortality of eggs. Mortality was highest amongst the older eggs. On the basis of the results and those of other workers, it is recommended that, in Wyoming, spraying or dipping should be carried out twice in October or November before the onset of cold weather, or once in October or November and again if necessary in February, or once in December or January if the herd is not available earlier.

GILBERT (I. H.) & GOUCK (H. K.). **Influence of Surface Color on Mosquito Landing Rates.**—*J. econ. Ent.* **50** no. 5 pp. 678–680, 2 figs., 3 refs. Menasha, Wis., 1957.

An account is given of tests carried out to compare the landing rates of *Aëdes aegypti* (L.), *A. taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.) on paper disks of different colours and different intensities of colour. The disks were treated with dyes of red, orange, yellow, green, blue, violet and black at different concentrations to provide a range of shades. The results are shown on graphs. The darker shades of any one colour were progressively more attractive to *A. aegypti* than the lighter shades. The ratios of landings on the darkest shade of each colour to white ranged from 2·9 for black to 7·7 for violet. The lighter shades attracted *A. taeniorhynchus* more than dark, the ratios for the darkest shades to white ranging from 0·4 for black to 0·7 for blue. The darker shades of the brighter colours and the lighter shades of the colours containing blue were most attractive to *A. sollicitans*. Little preference was shown with the different shades of black. The ratio for the darkest shades to white ranged from 0·3 for violet to 1·2 for orange. With disks reflecting about 40 foot-candles of light, the most attractive colour for *A. aegypti* was yellow, followed in order by orange, red, green, violet, black and blue. The order of preference for *A. taeniorhynchus* was orange, green, yellow, blue, violet, red and black, and for *A. sollicitans*, black, blue, orange, green, yellow, violet and red. All were more attractive than white to *A. aegypti* and *A. sollicitans* and less attractive than white to *A. taeniorhynchus*. Ultra-violet, visible and near infra-red spectral directional reflectance curves were obtained for the disks that reflected 40 foot-candles. There was a negative correlation between the landing rates and the amount of light reflected in the wavelength range of 475 to 525 millimicrons with *A. aegypti* but not with the other species [*cf. R.A.E.*, B **42** 57].

Hopkins (T. L.) & Robbins (W. E.). **The Absorption, Metabolism, and Excretion of C^{14}-labeled Allethrin by House Flies.**—*J. econ. Ent.* **50** no. 5 pp. 684–687, 9 refs. Menasha, Wis., 1957.

The following is partly based on the authors' summary. Allethrin labelled with ^{14}C on the chrysanthemic acid moiety was used to study the fate of a pyrethroid insecticide in female house-flies (*Musca domestica* L.) of a DDT-resistant strain. To study the absorption and excretion of allethrin or its degradation products quantitatively, a method was devised for attaching house-flies in stationary positions throughout the experimental period, by cementing them by the sterna to strips of Scotch tape on glass plates. Excreta were collected on filter paper. For treatment, immobilised flies were lightly anaesthetised with carbon dioxide, and the allethrin in acetone solution, alone or with piperonyl butoxide at a ratio of 1:1, was applied to the dorsal thoracic surface. Allethrin was rapidly absorbed, metabolised and excreted, 46·1 and 76·3 per cent. of the applied dose being absorbed in 4 and 24 hours, and 6·5 and 44·4 per cent. of the absorbed dose excreted in these periods. When piperonyl butoxide was applied with the allethrin, both absorption and excretion were retarded, the corresponding percentages being 40·5, 65, 4·7 and 36·4. Almost all the absorbed dose of allethrin was metabolised in 24 hours. The bulk of the radioactivity present in the homogenates and excreta behaved as an unknown metabolite, only trace amounts of unchanged allethrin or free acids being detected. No qualitative differences were found in the metabolism of allethrin applied alone or jointly with piperonyl butoxide.

Snow (W. E.). **Flies attracted to the Giant Star Flower** (*Stapelia gigantea* **N. E. Br.**).—*J. econ. Ent.* **50** no. 5 pp. 693–694, 1 ref. Menasha. Wis., 1957.

The flowers of *Stapelia gigantea* are known to attract flies. Insects collected from two flowers of this plant in the yard of a house in Sheffield, Alabama, in the early afternoon of 4th October 1956 comprised seven adults of *Lucilia* (*Phaenicia*) *cuprina cuprina* (Wied.) (*pallescens* Shann.), 11 of *Phormia regina* (Mg.), 18 of *Hippelates pallipes* (Lw.), five of *H. pusio* Lw., one of *Ophyra leucostoma* (Wied.), two of *Fannia* sp., two of *Sarcophaga* spp., and one of *Brachymeria fonscolombei* (Duf.), a Chalcid parasite of Muscoid flies. Two Muscoid larvae and 40 eggs were also collected from the flowers, but they did not develop in the laboratory. Apparently the smell of the flower stimulates oviposition, but the medium is not suitable for development. It is suggested that the attractant in the flower might be of use in fly control.

Davis (R.). **Control of the Myocoptic Mange Mite,** *Myocoptes musculinus* **(Koch), on Laboratory Mice.**—*J. econ. Ent.* **50** no. 5 p. 695. Menasha. Wis., 1957.

A heavy infestation by *Myocoptes musculinus* (Koch) was found on a laboratory colony of white mice kept on peat moss litter in large glass jars with 0·25-inch hardware cloth lids. All mice killed for examination were found to be carrying more than 500 mites. In preliminary tests, 2 per cent. malathion gave effective control of the mites without causing visible harm to the mice, whether used as a dip or as litter treatment. Dipping the mice at weaning time in a 2 per cent. malathion emulsion and putting them in clean jars completely controlled the infestation, and examination of mice periodically for four weeks failed to give any indication of its re-establishment.

de Rodaniche (E.). **Isolation of the Virus of Ilhéus Encephalitis from Mosquitoes of the Genus** *Psorophora* **captured in Honduras.**—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 797–801, 11 refs. Baltimore, Md., 1956.

The neurotropic virus isolated from a pool of 50 mosquitos of the genus *Psorophora* taken in Honduras in 1954 [*R.A.E.*, B **46** 130] was subsequently found by J. Casals to be identical with or closely related to the virus of Ilhéus encephalitis [*cf.* **38** 107; **46** 159], and in animal pathogenicity and other properties also it corresponded with the Ilhéus virus. It was maintained by serial passage in mice, for which it increased in virulence, and attempts to infect six other common kinds of laboratory animals failed. The mosquito pool from which it was isolated comprised mainly *P. ferox* (Humboldt) but included also *P. lutzii* (Theo.) and *P. varipes* (Coq.).

Sudia (W. D.), Stamm (D. D.), Chamberlain (R. W.) & Kissling (R. E.). **Transmission of Eastern Equine Encephalitis to Horses by** *Aedes sollicitans* **Mosquitoes.**—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 802–808, 2 graphs, 7 refs. Baltimore, Md., 1956.

Although horses are highly susceptible to eastern equine encephalitis (EEE), they seem rarely to develop enough virus in their blood to serve as an efficient source of infection for mosquitos. Studies of the EEE infection thresholds [*R.A.E.*, B **44** 38] of many different species of mosquitos [**44** 40] indicated that *Aëdes sollicitans* (Wlk.) was one of the most susceptible, with a probable threshold of about 10^{-3}, and TenBroek & Merrill reported in 1935 that they had transmitted infection from horse to horse with this mosquito. Quantitative studies were therefore made to determine more accurately its capabilities in spreading EEE infection among horses.

Six batches of 50–80 normal females were fed, at a time when temperatures indicated that viraemia was high, on a horse that had been inoculated with 25,000 mouse intracerebral LD50's of EEE virus. The titre of virus circulating in its blood reached $10^{-5.5}$, a level not commonly attained in horses, but it recovered. After 11–12 days' incubation, ten mosquitos from each batch were ground individually and inoculated into mice. From the fate of the mice two days later, it was estimated that from 10 to 40–50 per cent. of the mosquitos in the six batches were infected. Up to 500 times as much virus as the amount ingested was recovered from some of the mosquitos. Mosquitos of five out of the six batches transmitted the infection to chicks. They had fed on the horse when the titre of virus in its blood was $10^{-4.8}$ or more, whereas the batch that did not transmit had fed when the titre was $10^{-4.4}$. On the 14th day of incubation, 29 mosquitos from one of the most heavily infected groups were refed on a normal horse. This horse developed a fatal infection, but its blood had a lower, more usual titre of virus, not rising above $10^{-3.2}$. Attempts to infect more mosquitos by allowing them to feed on it were unsuccessful, possibly because times of feeding were based on temperature, and titres had fallen to $10^{-2.2}$ or less when temperature was highest. In the presence of large numbers of low-threshold mosquitos and a high percentage of non-immune horses and birds, an occasional horse infective for mosquitos could be of significance in an epizootic [**44** 39].

INGRAM (R. L.), LARSEN jr. (J. R.) & PIPPEN (W. F.). **Biological and Bacteriological Studies on** *Escherichia coli* **in the Housefly,** *Musca domestica*.—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 820–830, 3 graphs, 11 refs. Baltimore, Md., 1956.

The following is based on the authors' summary of work designed to test certain techniques for the laboratory study of the transmission of enteric bacteria by flies (*Musca domestica* L.) and to provide information on the ability of flies to take up and transmit *Escherichia coli* under laboratory conditions. One feeding a day of milk and sucrose was found to be enough to maintain the flies. Water, when offered, was generally rejected and did not significantly increase the survival time. Caged flies under normal insectary conditions lived considerably longer than did flies immobilised for test by mounting them on glass rods coated with paraffin wax [*cf.* *R.A.E.*, B **41** 188]. In general, *E. coli* did not appear to multiply in the insect's alimentary canal. Rather more than half the bacteria ingested were recovered. There was no significant difference in the bacterial output of flies fed on diets containing different amounts of sucrose in skim milk, but this would have had to be great in order to be significant because of the variations in the total counts within the diets. Almost all the bacteria were released by the time half the flies died. When flies were fed on *E. coli* tagged with ^{32}P, there was fairly good correlation for several days between the radioactive and bacterial counts. The rate of uptake of *E. coli* from an infective bait by caged flies was determined. The maximum number of bacteria was found after 45–60 minutes. After this, there was an apparent decrease for about five hours, and then an apparent increase, indicating a revisit by the fly to the source of the organisms.

FOX (I.). **Murine Typhus Fever and Rat Ectoparasites in Puerto Rico.**—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 893–900, 7 figs., 9 refs. Baltimore, Md., 1956.

The following is virtually the author's summary and conclusions. The remarkable reduction in murine typhus in the southern United States is generally attributed to large-scale control measures, particularly DDT dusting to kill rat fleas [*cf.* *R.A.E.*, B **39** 108; **40** 166]. Notwithstanding that such control operations were not in effect in Porto Rico, the reported rate dropped steadily and there was a 100 per cent. decrease in the City of San Juan (137 reported cases in 1944 and none in 1954). In an attempt to explain the decline of the disease, a study of rat ectoparasites, together with human and rat serological surveys, was undertaken. Ectoparasite data from 600 rats collected in the city from 15th April 1954 to 4th May 1955, when compared with data from 775 rats trapped during the same period in 1946–47, demonstrated that the vector, *Xenopsylla cheopis* (Roths.) [*cf.* **40** 189], had decreased in population sufficiently to account for the lack of human cases, since the percentage of rats infested and the average number of fleas per rat were only 16 and 0·42 in 1954–55 as compared with 54 and 1·75 in 1946–47. Decrease in flea population was greater in the residential section (Santurce), where only 5 per cent. of the rats were infested, than in the largely business district (San Juan Islet), where 26 per cent. were still infested. As regards Santurce, data from earlier surveys indicated that there has been a consistent downward trend in rat-flea population during the last eight years. Complement-fixation tests on blood from 279 rats resulted in only 3·2 per cent. positive at dilutions of 1:8, indicating that infection among rats is negligible. Of sera of 368 human subjects, 3·8 per cent. were positive at dilutions of 1:4 or above. Since a positive reaction may be given years after recovery and because of very low titres as well as other reasons, it is believed that the reported rate is essentially correct and that there are few if any unreported cases.

On the basis of this evidence from Porto Rico, it is concluded that a reduced typhus rate is not proof of the efficacy of control operations. It is possible that control was instituted in the southern United States after the epidemic had already receded, and that without the large-scale control projects there the disease might have followed the same course as it has in Porto Rico. No explanation has yet been found for the decrease in the reproductive potential of *X. cheopis* during the last decade in San Juan, since rats are abundant and the climate has been favourable for flea development, at least as regards temperature and humidity. Improvements in construction, food storing, general sanitation and mosquito control may have had an incidental effect on rat fleas, but do not account for the great reduction in population that has occurred.

HURLBUT (H. S.) & WEITZ (B.). **Some Observations on the Bionomics of the common Mosquitoes of the Nile Delta.**—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 901–908, 6 refs. Baltimore, Md., 1956.

During a study of the epidemiology of infection with West Nile virus in the Nile Delta [*R.A.E.*, B **46** 158], observations were made on the seasonal and geographical distribution and feeding habits of the common mosquitos of the cultivated areas. Most of the collections were made with New Jersey light-traps operated from sunset to sunrise, usually four nights a week, in three villages about 20 miles north of Cairo. Of the total catch of 16,362 mosquitos obtained during the year from April 1953 to March 1954, *Culex antennatus* (Becker), *C. univittatus* Theo., *C. pipiens* (L.), *Aëdes caspius* (Pall.) and *Anopheles pharoensis* Theo. constituted 99·4 per cent. [*cf.* **43** 50], and collections in baited traps and diurnal resting places and larval collections confirmed the predominance of these species. *C. antennatus* was by far the most abundant, and, like *C. univittatus*, *A. pharoensis* and probably *Aëdes caspius*, was a warm-weather mosquito with greatest abundance in July, August, September and October. *C. pipiens* was most plentiful in April and May, with reduced numbers during July, August and September and a rise in October and November. It was present in appreciable numbers in the winter months, as indicated by catches in sleeping quarters in rural dwellings. Dissections gave evidence of continuous breeding throughout the winter [*cf.* **41** 207; **46** 159], and this was supported by the finding of males, larvae and eggs. The results of summer collections in the same area in 1952 and 1954 were in essential agreement with those of 1953, but extensive light-trap collections made further north, near the limits of the cultivated area, during the summer of 1954 indicated substantially lower mosquito densities. The peak abundance of *C. antennatus* and *Anopheles pharoensis* tended to come somewhat earlier in the north, and *C. univittatus* was relatively much less abundant.

Each of the five common species fed readily on man, but *C. pipiens* and

A. pharoensis appeared to be most strongly anthropophilous. *C. univittatus* probably had the most diverse feeding habits of the three species of *Culex*, and was the most strongly attracted to birds. *C. antennatus* fed generally on man and the large domestic mammals. *C. univittatus* was colonised without difficulty, and the colony was maintained for over two years. Mating took place readily in a cylindrical cage about 12 ins. in diameter and 16 ins. high. *C. pipiens* was colonised by the same technique, but *C. antennatus* failed to mate in captivity.

Lang (C. A.). **The Influence of Mating on Egg Production by** *Aedes aegypti*.—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 909–914, 12 refs. Baltimore, Md., 1956.

The effect of an opportunity for mating either before or after a blood-meal or both on oviposition by females of *Aëdes aegypti* (L.) [*cf. R.A.E.*, B **46** 151, etc.] was investigated under laboratory conditions. There was no difference in the feeding response of virgin and mated females. The numbers of eggs per female laid within seven days of the blood-meal by virgin females and females caged with males before the blood-meal, after it and continuously were 54·1, 70·3, 64·5 and 86·4, respectively. The number laid by the females of the last group was significantly the highest, but the differences for the other groups were attributable to the proportions of females in them that laid few or no eggs, as almost all the females that oviposited, regardless of their mating conditioning, laid about the same number. All eggs laid by virgin females were non-viable, and viability data provided evidence of successful mating in the females that were given the opportunity to mate. Since all those that had continuous opportunity to mate laid eggs and about one-third of the virgin females did not, it is considered justifiable to assume that a non-laying, engorged female has not mated successfully. On this assumption, it is tentatively concluded that the females kept with males before or after the blood-meal had equal chances of being mated, for similar percentages of these groups laid eggs. Virgin females, those given a continuous opportunity to mate and those of the other two groups laid 41, 3 and 7 per cent. of their eggs, respectively, more than seven days after the blood-meal.

Lang (C. A.) & Wallis (R. C.). **An artificial Feeding Procedure for** *Aedes aegypti* **using Sucrose as a Stimulant.**—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 915–920, 1 fig., 14 refs. Baltimore, Md., 1956.

In an examination of the feeding preferences of females of *Aëdes aegypti* (L.) for solutions of several chemically defined sugars and glycerin (offered on saturated pads), the percentages that " fed " (showed a lateral split exposing the pleura between the abdominal tergites and sternites of less than 0·5 mm.) and " engorged " (showed a split of more than 1 mm.) were 36 and 60 for sucrose, 32 and 50 for glucose, 50 and 21 for fructose, 21 and 18 for lactose and 15 and 0 for glycerin, all at the 5 per cent. level, and 0 and 0 for water alone. Results at the 10 per cent. level were similar, but the preference for sucrose was intensified. Engorgement on sucrose was much more rapid than on other solutions, and the mosquitos fed to repletion on unattractive test preparations when these were supplemented with sucrose. Oviposition following meals of sucrose-supplemented blood and of blood alone indicated that the addition of sucrose did not alter nutritional effectiveness with regard to egg production [*cf. R.A.E.*, B **42** 92].

Micks (D. W.) & McKibben (J. W.). **Report of a Case of human intestinal Myiasis caused by** *Leptocera venalicia.*—*Amer. J. trop. Med. Hyg.* **5** no. 5 pp. 929–932, 1 fig., 4 refs. Baltimore, Md., 1956.

The following is based on the authors' summary. A case of human intestinal myiasis due to *Leptocera venalicia* (O.-S.) is reported from Texas. This Borborid is not known to have previously caused myiasis in man. Larvae and pupae appeared in various stool specimens over a period of five months in 1952. The only symptoms were occasional episodes of gastric distress and abdominal cramps. Eggs or larvae had probably been ingested with contaminated meat or cheese.

Sen (P.) & Das Gupta (S. K.). **Males of** *Culicoides anophelis* **Edw.**—*Bull. ent. Res.* **49** pt. 3 pp. 415–416, 1 fig., 5 refs. London, 1958.

Culicoides anophelis Edw. is widely distributed in India, Ceylon, Burma, Malaya, Siam, Indo-China and Sumatra, and has been found in New Britain [*R.A.E.*, B **37** 233]. The females have frequently been collected in India in the act of engorging on females of *Anopheles* spp., but the authors have also found them attacking *Culex pipiens fatigans* Wied. and *Mansonia annulifera* (Theo.). The males were unknown, but the authors describe males collected in the environs of Calcutta that they consider to belong to this species on the grounds of their similarity to the females.

Davies (J. B.). **An Attempt to eradicate** *Glossina palpalis* **(R.-D.) and** *G. tachinoides* **Westw. from riverine Vegetation in Benue Province, Northern Nigeria, by Spraying with DDT.**—*Bull. ent. Res.* **49** pt. 3 pp. 427–436, 1 pl., 4 figs., 5 refs. London, 1958.

During 1955 and 1956, attempts were made to eradicate *Glossina palpalis* (R.-D.) and *G. tachinoides* Westw. from 8¼ miles of heavily forested perennial river in Benue Province in the Northern Region of Nigeria by using DDT [*cf. R.A.E.*, B **45** 105]. The experimental and control rivers are described. The DDT was used as a 2·5 or 5 per cent. suspension prepared from a 50 per cent. paste or wettable powder at rates varying from about 10 to 36 lb. DDT per mile. It was applied from knapsack sprayers to the underside of overhanging vegetation and the trunks and branches of trees within 6 ft. of the ground, and also to roots projecting from steep banks. Three applications to the bank vegetation between January and May 1955, with the first extended for 20 yards inland, reduced the fly populations considerably, but there was also an appreciable decrease in the control stretch so that the exact effect of the spraying could not be determined. Four applications at fortnightly intervals were decided on for the next season, to cover two pupal periods at a time when populations were expected to be on the increase, and these were carried out between 5th December 1955 and 3rd February 1956, with the first extended for 10 yards inland. However, as flies were still to be found after them, a further treatment of selected sites only was made in March. *G. palpalis* was eliminated for a period of 124 days from 23rd February to 29th June, but a small population subsequently established itself, and it was evident that isolation was inadequate. *G. tachinoides*, which was near the southern limit of its range and was present in much smaller numbers, disappeared from both the treated and control rivers, so that there was no evidence of the effect of the insecticide on it. The cost of spraying was about half the cost of clearing by normal current methods.

The catches on the control river showed that the population of *G. palpalis* declined to a minimum during the wet season and indicated that the early and middle part of the dry season afforded optimum conditions for its increase. This is the reverse of the findings made by Nash & Page a little further north [**42** 155–156], and is thought possibly to be the result of dispersal away from rivers in the wet season, and also perhaps of an adverse effect of rainfall in excess of 4 ins. per month. In 1956, when the rains were long and slight, the average monthly catch remained almost constant throughout the year.

Goma (L. K. H.). **The Productivity of various Mosquito Breeding Places in the Swamps of Uganda.**—*Bull. ent. Res.* **49** pt. 3 pp. 437–448, 11 refs. London, 1958.

The effects of man's interference on the mosquito fauna of Uganda swamps [*cf. R.A.E.*, B **23** 93; **37** 163] was studied at two papyrus swamps between mid-January and early April 1957. The habitats in the swamps were classified into five types according to whether the papyrus (*Cyperus papyrus*) had been cut or burnt recently or 2–5 months before or was virgin (or completely regenerated), and the periphery of swamps with permanent and semi-permanent pools constituted a sixth type. Altogether, 5,781 larvae were studied. They comprised two species of *Anopheles*, seven of *Culex* and eight of other genera, but none of the genus *Mansonia*, which could not be taken by the method of collection used. *Culex guiarti* Blanch., *C. univittatus* Theo. and *C. rubinotus* Theo. were the dominant species, and together comprised 78 per cent. of the total. *Anopheles coustani* Lav. was taken in five types of habitat and comprised 3 per cent. of the total, but *A. funestus* Giles was represented by only eight larvae, all from the peripheral zones. Of the total number of larvae, the percentages in the different types of habitat were 49·9 in the peripheral zone, 21·6 where the papyrus was recently cut, 11·9 and 11·2 where it was virgin or had been cut a longer time, and only 2·7 and 2·7 in the two burnt areas. Of the six chemical factors investigated (pH, potassium, sodium, absorbed oxygen, free and saline ammonia and albuminoid ammonia), only the amount of soluble organic matter, indicated by absorbed oxygen and albuminoid ammonia, showed any relation to breeding, the least productive habitats containing the least organic matter. Other factors that might affect breeding, but were not investigated, are the nature of soluble oxidisable organic matter, conductivity, ferruginous surface films and iron in solution.

Colless (D. H.). **Notes on the Culicine Mosquitoes of Singapore. I. Three new Species of** *Culex* **(Diptera, Culicidae) and a Redescription of** *Culex hutchinsoni* **Barraud.**—*Ann. trop. Med. Parasit.* **49** no. 3 pp. 311–319, 4 figs., 3 refs. Liverpool, 1955. **II. The** *Culex vishnui* **Group (Diptera, Culicidae), with Descriptions of two new Species.**—*Op. cit.* **51** no. 1 pp. 87–101, 3 figs., 12 refs. 1957. **III. Larval Breeding-places.**—*T. c.* pp. 102–116, 2 figs., 12 refs.

The contents of the first of these papers is indicated by its title, and the following paragraphs are almost entirely based on the author's summaries of the other two.

Four species of *Culex* that occur in Singapore are all identifiable in the adult stage as *Culex vishnui* Theo. as currently defined, but it is shown that none of them is conspecific with Theobald's type specimens of *C. vishnui*, which differ markedly from any extant description. Two of them are identified with *C. annulus* Theo. and *C. perplexus* Leic., and the other two are described as *C. pseudovishnui*, sp.n. (which is clearly the species that has usually, but erroneously, been referred to as *C. vishnui*) and *C. alienus*, sp. n. The Malayan form of *C. tritaeniorhynchus* Giles is also described in detail. It is identical with *C. tritaeniorhynchus* var. *siamensis* Barraud & Christ. (1931) and is also shown to be identical with *C. summorosus* Dyar (1920). It is therefore treated as a subspecies, *C. tritaeniorhynchus summorosus*. Attention is drawn to the use of the siphon-saddle ratio, as a more convenient index of relative siphonal length than the conventional siphonal index.

The breeding places of mosquitos (other than *Anopheles* and *Mansonia*) in Singapore are described, and are classified into eight major categories, derived from those of Laird [*cf. R.A.E.*, B **46** 65]. The larval fauna typical of each category is described in detail, and an "index of association" is presented and used to indicate successions in the hyacinth-ponds (ponds in which *Eichhornia crassipes* and other plants are grown as pig-food). In these ponds, and also in freshwater marshes and obstructed streams, *C. t. summorosus* is the most widespread and plentiful mosquito. The evolution of adaptation to the larval habitat is discussed in general terms, particularly as regards the necessity for parallel adaptations in adult and larval biology.

HALE (J. H.), COLLESS (D. H.) & LIM (K. A.). **Investigation of the Malaysian Form of *Culex tritaeniorhynchus* as a potential Vector of Japanese B Encephalitis Virus on Singapore Island.**—*Ann. trop. Med. Parasit.* **51** no. 1 pp. 17–25, 3 figs., 10 refs. Liverpool, 1957.

After some 30,000 mosquitos had been examined in an attempt to find the vector of the virus of Japanese B encephalitis [*cf. R.A.E.*, B **40** 163] in Singapore, the virus was isolated from a pool of the Malaysian form of *Culex tritaeniorhynchus* Giles [subsp. *summorosus* Dyar (see preceding abstract)]. Experiments were therefore carried out to determine whether it could multiply in this mosquito and be transmitted by it. Females that had emerged in lamp glasses 12–24 hours before were offered pads of cotton-wool or lint soaked in suspensions of infected mouse brain in defibrinated blood containing a little sugar solution and placed on the netting that capped the glasses. The pads were put in position in late afternoon and usually left there overnight, and at least 90 per cent. of the mosquitos fed. It was found that a mosquito ingested about 0·00078 ml. suspension, and the concentration of virus in it was such that this amount would contain about 100 mouse intracerebral LD50's. After feeding, the mosquitos were anaesthetised with carbon dioxide and transferred to clean lamp glasses, which were kept over water and covered with a wet pad. Estimates of the virus content of representative samples showed an increase of about one thousandfold in all experiments after an initial decrease lasting about 48 hours. The virus was also ingested by mosquitos in suspensions containing sugar without blood, but ceased to be detectable in them after 6–12 hours. A blood-meal is taken directly into the gut, where some cells must permit the entry of the virus, but the sugar solution passes to a chitinous diverticulum, in which the virus has no point of entry and is probably destroyed as the sugar in the fluid is fermented.

Experiments on transmission were made by feeding the mosquitos on the clipped breasts of day-old chicks. Those that had acquired the virus from the suspensions transmitted it after 10, 13 and 20 days, but not after 5, 7 or 8. They could not be kept alive in the laboratory for more than 20 days. Mosquitos that were fed on artificially infected chicks when their blood contained 10^3–10^4 mouse intracerebral LD50's per 0·03 ml. infected fresh chicks ten days later, and the latter developed viraemia of the same order in 2–3 days.

A test in which mosquitos were given blood-meals containing various concentrations of virus and suspensions of them were inoculated individually into mice ten days later showed that the titre required to infect 50 per cent. of the mosquitos was $10^{3\cdot5}$ mouse intracerebral LD50's per 0·03 ml.

KERSHAW (W. E.), PLACKETT (R. L.), MOORE (P. J.) & WILLIAMS (P.). **Studies on the Intake of Microfilariae by their Insect Vectors, their Survival, and their Effect on the Survival of their Vectors. IX. The Pattern of the Frequency of the Blood-meals taken in by *Chrysops silacea* and of the Survival of the Fly in natural Conditions in the Rain-forest of the British Cameroons and on a Rubber Estate in the Niger Delta.**—*Ann. trop. Med. Parasit.* **51** no. 1 pp. 26–37, 5 graphs, 1 map, 13 refs. Liverpool, 1957.

The following is based on the authors' summary of this ninth paper of a series [*cf. R.A.E.*, B **45** 22; **46** 41, etc.]. By assessing the stage of development of larvae of *Loa loa* [*cf.* **10** 42] in infected adults of *Chrysops silacea* Aust. coming to bite man in nature it is possible to estimate the time that has elapsed since the infecting blood-meal was ingested and so to determine the pattern of frequency of feeding. In this way, it is shown that the pattern of biting over ten or more days is made up of two components, which merge into one another. There is a population of flies that feed in the first three or four days after an infecting meal, and again in the last three or four days, and which, when coming to bite and transmit the infection, contain infective larvae recognisable as at least tenth-day forms (though they are probably 12 days old or more). Secondly, there is a population that feeds on about the fifth day after an infecting meal and again about the tenth, when the infective larvae have only just completed their development.

The pattern of the survival of the flies in natural conditions is assessed by empirically fitting different rates of mortality to the two components and comparing the predicted number of survivors with the observed number. It is shown that the mortality rate is of the same order under natural as under laboratory conditions. While it is known that the rate of mortality in the laboratory increases with age [**44** 8], it is not possible, with the data at present available, to determine whether it does so in natural conditions or whether it is constant.

MARKS (E. N.). **Some Mosquitoes from Western Samoa, with a Description of a new Species of *Aëdes* (*Stegomyia*) (Diptera, Culicidae).**—*Ann. trop. Med. Parasit.* **51** no. 1 pp. 50–57, 2 figs., 13 refs. Liverpool, 1957.

A collection of eight species of mosquitos made on Upolu Island, Western Samoa, in January 1956 was found to include six that had previously been recorded from Samoa (*Aëdes samoanus* (Grünb.), *A. aegypti* (L.), *A. polynesiensis* Marks, *Culex pipiens fatigans* Wied., *C. annulirostris* Skuse and *C. sitiens* Wied.) and a species of *Mansonia* (*Taeniorhynchus*). Collection data are given for these seven species, together with brief morphological notes on some of them. The eighth is a member of the subgroup of *A. scutellaris* (Wlk.) [*R.A.E.*, B **43** 173], and is described from larvae, pupae and adults of both sexes as *A. upolensis*, sp. n. Characters are given distinguishing the adults and larvae from those of *A. polynesiensis* and the adults from other members of the subgroup, including *A. pseudoscutellaris* (Theo.) and *A. tongae* Edw., which occur on adjacent island groups (Fiji and Tonga), and may have been derived from a common ancestor. The production of fertile hybrids by crossing *A. pseudoscutellaris* with *A. polynesiensis* [**42** 161; **43** 202–203] makes their specific distinctness doubtful until their relationships are studied in Fiji, where they occur together, but it is considered advisable to regard *A. upolensis* as a species, at least until its relationships with its neighbours can be clarified. It is a rain-forest species and attacks man near its breeding places; the type series was obtained from a hole in the top of a tree-fern stump. An insertion to include it is given for the author's key to the *scutellaris* subgroup [**43** 174].

CROSSKEY (R. W.). **Man-biting Behaviour in *Simulium bovis* De Meillon in Northern Nigeria, and Infection with developing Filariae.**—*Ann. trop. Med. Parasit.* **51** no. 1 pp. 80–86, 1 map, 12 refs. Liverpool, 1957.

Until recently, *Simulium damnosum* Theo. was the only Simuliid known to attack man in Northern Nigeria, but *S. bovis* De Meillon has now been found to do so in several parts of the country including the northern Abuja Emirate [*cf. R.A.E.*, B **46** 128], where observations on it were made in 1955 and 1956. The area in question, which is briefly described, has three main rivers, and *S. bovis* was found to breed in two of them, occurring in rocky-bedded stretches, with rapids and falls, turbulent water and partly submerged trailing grass, but not in the third, despite the presence of apparently favourable rapids in which *S. damnosum* was abundant. Pupae were found in all months except July–September, when the rivers were too deeply flooded for survey, but the adults were taken only in the five months of the rainy season (June–October). They were found at distances of up to 14 miles from their breeding places, and attacked man in the open or in light shade between 8 a.m. and 6 p.m. but principally before 10 a.m. and in the late afternoon. They showed a preference for the legs and were easily disturbed. They were also taken on cattle, which are probably the normal hosts, and most of the feeding on man occurred where cattle were scarce or absent. Dissection of 116 females from a locality in which onchocercosis was prevalent and the density of *S. damnosum* low, showed seven to be harbouring filariae morphologically indistinguishable from *Onchocerca volvulus*, three of them having active infective larvae in the thorax. As there were no cattle within ten miles, it is unlikely that the filariae were those of a bovine *Onchocerca*, but the possibility that *S. bovis* may act as a vector of *O. volvulus* cannot be investigated further in the Abuja area, as it has been almost eradicated by treatment of its main breeding-river with larvicide against *S. damnosum*.

BURGDORFER (W.). **The possible Role of Ticks as Vectors of Leptospirae. I. Transmission of *Leptospira pomona* by the Argasid Tick, *Ornithodoros turicata*, and the Persistence of this Organism in its Tissues.**—*Exp. Parasit.* **5** no. 6 pp. 571–579, 3 figs., 9 refs. New York, N. Y., 1956.

During studies on the development of relapsing-fever spirochaetes in tick vectors at the Rocky Mountain Laboratory in Montana, large masses of leptospiras were observed in the coxal organs, salivary glands, central ganglion and tissues of the genital and excretory systems of an individual of *Ornithodoros turicata* (Dugès). The remaining tissue of the tick was triturated and inoculated intraperitoneally into two weanling guineapigs and a leptospira, characterised serologically as *Leptospira ballum*, was later recovered from the blood of both of these. Leptospiras have been observed four times in four years in the circulating blood of adult mice reared at the laboratory, and it is probable that the tick acquired the infection from such mice. Previous attempts by various workers to obtain transmission of leptospiras by arthropods have seldom been successful, and the few transmissions obtained appeared to be mechanical, until recent demonstrations of the survival and development of *L. icterohaemorrhagiae* in *O. moubata* (Murr.) and *O. turicata* [*R.A.E.*, B **43** 77; **46** 103] and its transmission from guineapig to guineapig by *O. moubata* [**43** 77]. These observations on *L. ballum* and *L. icterohaemorrhagiae* led to a series of experiments in which both Argasid and Ixodid ticks were examined for their ability to serve as possible vectors of leptospiras.

The tests described in this paper were made with a strain of *O. turicata* originating from rodent burrows in New Mexico and a strain of *L. pomona* that had been isolated from pigs in Illinois in 1953 and is not fatal for guineapigs but causes fever lasting 3–5 days in them. Nymphs and adults of the tick were allowed to engorge on the air-sac membrane of embryonated hens' eggs that had been inoculated 4–5 days previously with a tenth passage of the leptospira, and some of them were subsequently fed in groups of 3–10 on weanling guineapigs. The infection was transmitted in 14 out of 34 such attempts and after periods ranging from 37 to 232 days. Since the leptospiras are far more numerous in embryonated hens' eggs than in the blood of wild rodents, about 50 ticks were fed on infected hamsters (*Cricetus auratus*), and 25 of them were allowed to engorge on a guineapig 33 days later. The guineapig became infected. Large numbers of leptospiras were regularly ejected with the coxal fluid of infected ticks. The leptospiras were easily seen in the midgut and its diverticula for 2–3 days. In ticks that became infected (about 36 per cent. in these experiments), they penetrated the gut wall, sometimes as early as five days after engorgement. Multiplication occurred in the haemocoele, and infection eventually extended to the salivary glands, central ganglion, coxal organs and tissues of the excretory and genital systems. It persisted for 518 days (the period of observation). Leptospiras were also found in developing egg follicles, but no evidence of transovarial transmission was obtained. The results suggest that *O. turicata* may transmit *L. pomona* in nature. It has been collected from cattle, pigs and rodents, which are known to be subject to leptospirosis, and from a wide variety of other hosts, including man.

Combiesco (D.). **Fièvre "Q" (typhus pulmonaire—rickettsiose pulmonaire).**—*Arch. roum. Path. exp. Microbiol.* **16** no. 1 pp. 37–55, 31 refs. Bucharest, 1957. (With Summaries in Russian & German.)

The history of Q fever, caused by *Coxiella* (*Rickettsia*) *burneti*, is briefly reviewed and its symptoms are described. It was first identified in Rumania in 1946 and occurred, sometimes in small epidemics, in various parts of the country during the next ten years. Accounts are given of experiments made there, which demonstrated that infection can be airborne or may be transmitted in milk, by way of the placenta, or through broken skin or the conjunctiva. In 1947, suspensions of various arthropods (*Ixodes ricinus* (L.). *Rhipicephalus sanguineus* (Latr.), *Musca domestica* L. and *Hippobosca equina* L.) taken from animals belonging to some of the first people in whom the disease was recognised in Rumania were inoculated into guineapigs. Positive reactions were seen in the guineapigs inoculated with examples of *H. equina* that had been collected on horses and kept in the laboratory for five or seven months, but not in those inoculated with the other species. In subsequent experiments, sheep keds (*Melophagus ovinus* (L.)) acquired infection by feeding on an experimentally infected guineapig, and caused infection in normal guineapigs into which they were inoculated after feeding for 12–32 days on experimentally infected sheep. *Rhipicephalus sanguineus* taken from stray dogs in Bucharest transmitted the infection from guineapig to guineapig by feeding as well as by inoculation.

Sandulesco (M.) & Marotinesco (S.). **Détermination des femelles d'** *Anopheles sacharovi* (*elutus*) **et des variétés du groupe** *Anopheles maculipennis*, **par l'identification des "ovipositions obtenues par dissection".**—*Arch. roum. Path. exp. Microbiol.* **16** no. 1 pp. 144–149. Bucharest, 1957. (With Summaries in Russian & German.)

A study of the distribution of the various races of *Anopheles maculipennis* Mg., and particularly *A. m. sacharovi* Favr (which the authors treat as a distinct species), on the Black Sea coast of Rumania in 1955 was complicated by the intensive use that had been made of DDT and BHC since 1949 and the contamination of the laboratory and its surroundings, which resulted in too few of the captured females laying eggs for satisfactory identification of populations. In spite of cleaning, renewal of equipment and other precautions, only 30·8 per cent. of the females collected in June–September oviposited. Many died in the cages before they had matured their eggs. Dissection of all those that died in stages six and seven of Sella [*cf. R.A.E.*, B **32** 50], equivalent to stage five of Christophers [**29** 93], was therefore tried and was found to provide eggs that were entirely satisfactory for identification. After removal of legs, wings and salivary glands and removal and examination of the stomach, a drop of tap water is put on the ovaries and the ovarian wall ruptured to liberate the eggs. These are then transferred to a piece of dry filter paper on another slide, left for 2–3 hours to take their natural shape and examined under magnification. If too long an interval has elapsed before examination, a few drops of water should be added. The morphological characters of the eggs so obtained are identical with those of eggs obtained normally, and satisfactory eggs can be obtained in the hot season from females kept for a few hours in a humid atmosphere before dissection.

It was found possible to identify 1,370 of the 1,484 females collected, but the proportions of the various forms among them were altered by the method of identification so that *maculipennis* (*typicus*), *messeae* Flni., *atroparvus* van Thiel and *sacharovi* represented 7·8, 32·7, 32 and 27·4 per cent. of the 459 females identified by the eggs they laid, 3·6, 19, 8·7 and 68·7 per cent. of the 911 identified by the eggs dissected from them, and 5·1, 23·6, 16·5 and 54·8 per cent. of the total number. The differences with method of identification are attributed to differences in vigour of the forms and consequently in the percentages that survive to oviposit. Dissection of eggs greatly increases the number of females that can be identified at any time, but does so particularly in spring and autumn, when temperature reduces normal oviposition.

Mathis (W.), Schoof (H. F.), Quarterman (K. D.) & Fay (R. W.). **Insecticide Resistance of** *A. quadrimaculatus* **in Bolivar County, Miss.**—*Publ. Hlth Rep.* **71** no. 9 pp. 876–878, 6 refs. Washington, D. C., 1956.

Despite the widespread use of DDT against adults of *Anopheles quadrimaculatus* Say in the south-eastern United States in 1946–50, there has been no indication of the development of DDT resistance in this mosquito [*cf.* *R.A.E.*, B **45** 144]. A decreased susceptibility to larvicidal treatments was reported by the Tennessee Valley Authority [**41** 72], but later studies indicated that factors other than resistance were responsible. Dieldrin, however, was unexpectedly ineffective against Anopheline larvae in Mississippi in 1953 [**43** 7], and field studies in Bolivar County have now shown that, while *A. quadrimaculatus* is still susceptible to DDT in that area, it is highly resistant to dieldrin, BHC and chlordane. Females collected from five localities in Bolivar County during June and July 1955, kept overnight with food and water and exposed for 45 minutes on paper treated by immersion in solutions containing 0·25 and 1 per cent. dieldrin and 1 per cent. DDT suffered mortalities of 18, 6 and 96 per cent., respectively. In subsequent tests in which the mosquitos were exposed for 30 minutes to plywood panels treated with known deposits of insecticides, the mortality percentages of the Bolivar strain and (in brackets) a laboratory strain were 8 (98), 5 (100), and 0 (100) for dieldrin at 25, 100 and 200 mg. per sq. ft., 3 (67) for BHC (36 per cent. γ isomer) at 50 mg., 5 (44) for chlordane at 100 mg. and 53 (50) for DDT at 200 mg. Exposure to DDT at 200 mg. for the same period had given an average of only 44 per cent. kill of the same laboratory strain in 1948, and mortality of the Bolivar strain was increased to 85 per cent. by prolonging the exposure to 120 minutes. The development of resistance to dieldrin, chlordane and BHC is attributed to the extensive use of dieldrin and related insecticides in dusts applied from the ground and from aircraft against pests of cotton.

JONES (R. H.), BRUNDRETT (H. M.) & RADELEFF (R. D.). **Ranch Tests against Cattle Grubs with the systemic Insecticide Dow ET-57.**—*Agric. Chem.* **12** no. 7 pp. 45, 95–96, 1 ref. Baltimore, Md., 1957.

As Dow ET-57 [purified O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate] showed much promise as a systemic insecticide for the control of *Hypoderma* in small-scale tests in Oregon and Texas in 1955 [*R.A.E.*, B **46** 54, 88–89], an experiment was made in 1956 on seven ranches in Texas, on which infestation by *H. lineatum* (Vill.) was known to occur. About half the cows and calves on each ranch were left untreated and the other half, and a few bulls, received an estimated dose of 110 mg. Dow ET-57 per kg., given orally in a wettable-powder suspension containing 11 per cent. actual insecticide, in June and early July, when it was estimated that the larvae present were in the first-instar, primarily in the gullet. Larvae encysted in the backs were first observed on the different ranches from the end of July to mid-October, they were most numerous about the first week in December, and the experiment was concluded in January 1957. Totals of 127 untreated and 123 treated cows and yearling heifers and four untreated and seven treated heifer calves remained available for inspection until the end of the experiment. Of the cows and yearlings, 106 untreated and 52 treated were infested, with totals of 1,259 and 162 larvae, respectively, representing an overall control of about 87 per cent. The treated and untreated calves had 1·6 and 12·2 larvae per animal. One of two treated yearling bulls had 25 larvae and the other had none. No toxic effects on the cattle were reported.

MACLEOD (J.). **A preliminary Experiment on the local Distribution of Blowflies.**—*J. Anim. Ecol.* **25** no. 2 pp. 303–318, 1 pl., 2 refs. Oxford, 1956.

The following is mainly based on the author's summary. In view of the proposed use of carrion-baited traps in studies of blowfly populations in

England, the effect of having the traps at grass-tip level and raised 3 ft. above it was compared by distributing five pairs of traps in a rough circle less than 100 yards in diameter, in ecologically uniform terrain near Carlisle. Tests were made in May, July and October 1949, June and September 1950 and June and October 1951. The catch consisted mainly of *Lucilia* spp., *Calliphora vicina* R.-D. (*erythrocephala* (Mg.)), *C. vomitoria* (L.), *Phormia terraenovae* R.-D. and *Cynomyia mortuorum* (L.). Unsuspected sources of variability in sampling by this method were revealed. After the three years, no clear-cut conclusions on the effect of trap height could be drawn by examining totals, or by analysing by seasons. Differences in catch between high and low traps varied considerably in amount in successive tests and did not consistently favour one or the other. Analysis of the differences suggests that the catch-response to trap-height is affected both by the differences between days and by season. These affect the species distribution of the flies caught, and this in turn affects the relative catch of high and low traps. The position of a pair of traps in relation to replicate pairs influenced the catch-level for the pair. This "position effect" in an apparently uniform environment varied between days and for species. It appears to be due largely to the *Lucilia* component of the population, but indirect evidence is adduced for a similar effect with *Calliphora vicina*, the major component. A relation between species, position and height is inferred. Possible causes of the definite grouping of blowfly populations are briefly outlined.

CLYDE (D. F.) & KINGAZI (H.). **Diethyl Toluamide as a Mosquito Repellent.**—*E. Afr. med. J.* **34** no. 5 pp. 185–189, 1 graph, 2 refs. Nairobi, 1957.

An account is given of experiments in Tanganyika in which crude diethyl toluamide [*cf. R.A.E.*, B **46** 99] and dimethyl phthalate in a commercial cream of which it formed 40 per cent. by weight were compared for duration of repellent action against laboratory-bred females of *Anopheles gambiae* Giles and *Culex pipiens fatigans* Wied. Each test occupied 15 minutes in the dark and was made by exposing the treated forearm to the mosquitos in a small cage. The untreated forearm of the same person, put in the same cage immediately afterwards or in a cage of similar mosquitos at the same time, served as the control. Under the conditions prevailing (temperatures of 52–78°F. and 59–99 per cent. relative humidity), dimethyl phthalate was almost completely effective for 4–4½ hours and diethyl toluamide for 18–20 hours against both species and on both the people who carried out the tests, of whom one was African and the other European.

REID (E. T. M.). **The diagnostic Value of the Foretarsus in Male Anopheline Mosquitoes (Dipt., Culicidae).**—*Ent. mon. Mag.* **93** no. 1112 pp. 7–10, 1 fig., 3 refs. London, 1957.

The following is based on the author's summary. The foretarsal segments of males of 14 species of *Anopheles* from Southern Rhodesia were examined. It was found that the main taxonomic character lay in the shape and size of the tarsal claw and last tarsal segment. The numbers of sensillae on the first tarsal segment were of less significance since they varied considerably within a species. The numbers of sensillae on the second segment were significant in that they were absent from all six species of the subgenus *Myzomyia* studied and present in varying numbers in all but two of the others. It is concluded that the shape of the tarsal claw is not an ideal character in taxonomy although it is occasionally useful.

Brown (A. W. A.). **Insecticide Resistance in Arthropods.**—*Monogr. Ser. World Hlth Org.* no. 38, 240 pp., 29 figs., 28 pp. refs. Geneva, 1958. Price £1 5*s*., $5 or Sw.Fr. 15.

The object of this monograph is to collate all that is known about resistance to insecticides in arthropods of medical or veterinary importance, including data from over 600 papers and other publications and unpublished material communicated to the World Health Organisation during the past decade. The work is divided into four chapters of which the first (pp. 13–41) is concerned with the nature and characterisation of resistance, the second (pp. 42–103) with individual insects considered to be vectors of human disease, notably *Pediculus humanus humanus* L. (*P. h. corporis* Deg.), fleas and mosquitos, the third (pp. 104–186) with *Musca domestica* L., and the fourth (pp. 187–209) with other Diptera, *Cimex lectularius* L., *C. hemipterus* (F.), *Triatoma infestans* (Klug) (for which resistance has not been proved), cockroaches and ticks.

The subjects of the first chapter include the physiological and genetic origins of resistance, its development in model experiments and in the field, counter-measures involving the continued use of insecticides, and tests for the surveillance of susceptibility or detection of resistance. The chapter on *M. domestica* is divided into sections on the development of resistance in the various countries in which it has appeared, its production in the laboratory, the cross-resistance characteristics of resistant strains, the stability of resistance on release from insecticide pressure, differences distinguishing resistant from susceptible strains, the physiology of resistance to various insecticides, and the genetics of resistance to DDT and BHC.

Myers (K.). **Methods of sampling winged Insects feeding on the Rabbit** *Oryctolagus cuniculus* **(L.)**.—*C.S.I.R.O. Wildl. Res.* **1** no. 1 pp. 45–58, 1 pl., 8 refs. Melbourne, 1956.

As the important vectors of myxomatosis in eastern Australia include mosquitos (notably *Culex annulirostris* Skuse and *Anopheles annulipes* Wlk.) and Simuliids [*R.A.E.*, B **45** 207] and Ceratopogonids attack rabbits in some areas, a way of sampling the insects that are attracted to rabbits as a source of blood is needed for vector studies. Three traps devised for this purpose and found effective in tests on river-flats and on the sandy edge of Lake Urana in New South Wales are described. One, termed the cone-trap, is for use in the open, one is to catch insects leaving warrens and one to catch those entering. The first is a cone of marquisette, with a cylindrical calico hem, on an iron framework 3 ft. high and 3 ft. in diameter at the bottom, which is suspended above a living rabbit and can be quickly but gently dropped over it. A large sleeve allows access to the interior for collecting the catch. There are two iron rings 3 ins. apart in the hem to facilitate collection of the trapped insects with an oral aspirator and for the same reason the apex of the cone is closed by a Perspex disk 6 ins. in diameter. The rabbit is held firm in a netting cylinder stapled to a hardboard base, and its head is held by a pillory. The warren-exit trap is a truncated cone of marquisette, also on an iron framework, and has unbleached calico at the top and closing the base, fastened about the frame by draw-cords. The 9-inch opening at the top is directed into the mouth of a burrow, and a flaring skirt about it, secured with wire pins, allows for variations in the size of the burrow mouth. The warren-entrance trap is a cylinder of wire gauze 30 ins. long and 5 ins. in diameter supported by an iron framework, with a large flaring skirt dyed to tone with the soil, fitted about its open end and pinned around the burrow entrance after the cylinder has been inserted.

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In tests with the cone-traps, the size of catch did not vary with individual rabbits. The trap did not allow free approach at heights below 6 ins.; at 6 ins. it intercepted and provided resting places for engorged mosquitos flying outwards. At greater heights, it acted as a sampling mechanism only. When rabbits were exposed to an active population of *C. annulirostris* for varying lengths of time, catches rose steeply with exposures up to 15 minutes, but did not rise further with longer exposures, as the numbers attracted were balanced by the numbers leaving. In a similar experiment with *A. annulipes*, numbers rose steeply during the first 15 minutes, remained steady between 15 and 20 minutes and then rose again. The number of mosquitos caught increased with the distance separating the rabbits, when this varied from 6 to 30 ft. As a result of the tests, observations on myxomatosis vectors were made with the cone-trap suspended at a height of 1 ft. over rabbits at least 30 ft. apart, and a minimum exposure period of 15 minutes was used.

With one exception, the mosquitos taken in the warren traps (18 of each type) comprised several hundred of each sex of *A. annulipes* and of *C. pipiens australicus* Dobr. & Drum., and smaller numbers of both sexes of *C. annulirostris*. The tests with the exit traps showed that there was a mass emergence of mosquitos at dusk. Nine of the 378 females of *A. annulipes* taken in the 18 traps were freshly engorged with rabbit blood, suggesting recent feeding within the warrens. Catches from larger burrows were greater than those from smaller. Entrance traps put in place at 9 p.m. and cleared periodically during the next 24 hours showed a mass entry just after dawn. About 30 per cent. of the females of *A. annulipes* entering were freshly engorged with rabbit blood, suggesting a high rate of feeding on rabbits outside the warrens during the night [*cf.* **45** 208].

As an illustration of the potentialities of the cone-trap in ecological work, data obtained with it on mosquito activity on the ground and at different heights in tree canopy above it are given in an appendix (pp. 54–58).

KMET (J.), VESENJAK-ZMIJANAC (J.), BEDJANIČ (M.) & RUS (S.). **Virus Meningo-encephalitis in Slovenia. 1. Epidemiological Observations.** —*Bull. World Hlth Org.* **12** no. 4 pp. 491–501, 5 figs., 5 refs. Geneva, 1955.

BEDJANIČ (M.), RUS (S.), KMET (J.) & VESENJAK-ZMIJANAC (J.). **2. Clinical Observations.**—*T. c.* pp. 503–512, 1 graph, 5 refs.

VESENJAK-ZMIJANAC (J.), BEDJANIČ (M.), RUS (S.) & KMET (J.). **3. Isolation of the causative Agent.**—*T. c.* pp. 513–520, 2 refs.

LIKAR (M.) & KMET (J.). **4. Isolation of the Virus from the Ticks** *Ixodes ricinus.—Op. cit.* **15** no. 1–2 pp. 275–279, 4 refs. 1956. (With Summaries in French.)

The following paragraphs are largely based on the authors' synopses of the first and fourth papers of this series.

A description is given of the main epidemiological features of a special form of meningo-encephalitis that has been observed to occur in Slovenia, north-western Yugoslavia, since 1946. It is endemic there with occasional epidemic outbreaks, one of which occurred in 1953. It is markedly seasonal in its incidence, 95 per cent. of all cases in 1953 occurring during May–September, and the mention of tick-bite in the case history is characteristic. It is generally believed that *Ixodes ricinus* (L.) is the species concerned. The disease appears chiefly among people whose work lies in the woods, where the ticks are found, and no spread of infection from one person to another has been noted. The authors consider it probable that the virus circulates in enzootic foci between rodents and ticks and that man is accidentally infected.

In 1954, several unsuccessful attempts were made to isolate the virus from unengorged ticks collected at random, but this system was abandoned in 1955, and ticks were sought on the basis of evidence supplied by patients giving a history of tick-bite. In June, the peak endemic period, 18 males, 16 females and 108 nymphs of *I. ricinus*, all unengorged, were collected from a part of a forest in which one of the patients had been working. They were washed in alcohol, finely ground and centrifuged, and the supernatant was inoculated intracerebrally into suckling mice and intraperitoneally into adult mice and guineapigs. There was no evidence of infection in the adult mice or guineapigs, but the suckling mice showed symptoms of invasion of the central nervous system and died between the 14th and 18th day after inoculation, and intracerebral inoculation of a suspension of their brains produced the same pattern of pathogenicity in both suckling and adult mice. The virus obtained was identified by neutralisation and complement-fixation tests as that of meningo-encephalitis. It is concluded that *I. ricinus* is the main vector in Slovenia.

NEITZ (W. O.). **A Consolidation of our Knowledge of the Transmission of Tick-borne Diseases.**—*Onderstepoort J. vet. Res.* **27** no. 2 pp. 115–163, 14 pp. refs. Pretoria, 1956.

Basic information on the tick-borne diseases of livestock is given in a series of tables; so far as possible they show the vector or vectors and causal organism of each disease, whether the tick concerned requires one, two, three or many hosts for its development, the stages in which it acquires and transmits the infection, whether it retains it from generation to generation, the country in which the observation was made, and the authority for it, with the appropriate literature reference. Two of the diseases, tick paralysis and sweating sickness, are attributed to " toxins " because any other causal agent for them is unknown. Tick paralysis has been transmitted to various mammals by adults of 11 species of Ixodids, to sheep also by nymphs of *Ornithodoros lahorensis* Neum. [*R.A.E.*, B **34** 109] and to fowls, ducks and geese in South Africa by adults and possibly nymphs of *Argas persicus* (Oken). Sweating sickness is a disease of calves that occurs in various parts of Africa, but was not known to be tick-borne [*cf.* **23** 65] until the author recorded its transmission by adults of *Hyalomma truncatum* Koch (*transiens* Schulze) in 1954. He also found that sheep, goats and pigs are susceptible to it. All the ticks used in his studies were the progeny of a single female collected on a sick calf in Zululand, and the immature stages (which feed on rodents and birds in nature) were reared on rabbits. The ticks continued to transmit the toxin for five generations and retained it irrespective of whether the adults fed on a susceptible or immune calf or a horse, which is not susceptible to it.

The salient features of the information on the various diseases are summarised in the brief text. Transovarial transmission has been shown to occur in one or more of the vectors of most of them, and this suggests that ticks can serve as reservoirs of the causal agents, but the vectors of some occur where the diseases they transmit are unknown, so that the introduction of infected animals would be dangerous. Reference is also made to vectors other than ticks that can transmit some of the diseases.

NEITZ (W. O.). **Studies on the Aetiology of Sweating Sickness.**—*Onderstepoort J. vet. Res.* **27** no. 2 pp. 197–203, 3 refs. Pretoria, 1956.

The view that the causal agent of sweating sickness is a toxin produced by adults of *Hyalomma truncatum* Koch (*transiens* Schulze) in the process of feeding [*cf.* preceding abstract] and not a virus, as previously supposed, was suggested by repeated failure to transmit it from calf to calf by various methods of inoculation and supported by the experiments at Onderstepoort described in this paper, which show that it does not multiply in the vertebrate host and that the severity of the reactions produced by it depend on the duration of feeding of the ticks. It has been found possible to breed large numbers of ticks that can be relied on to transmit the disease without fail to susceptible animals, and batches of such ticks were allowed to feed on the ears of calves or white pigs to infect them or test whether they had acquired immunity. White pigs are particularly suitable test animals as it is easy to detect the characteristic hyperaemia of the skin as an early symptom, and the development of pharyngeal and laryngeal lesions can be judged by changes in the tone and pitch of their squeals.

Calves on which 16, 12 and 7 ticks fed for one, two and three days showed no reaction and were susceptible on challenge. Feeding for three days by 12 or more ticks caused no reaction, but resulted in the development of immunity in a calf and in three out of four pigs. Feeding periods of five days or more and generally those of four days were followed by reactions that were usually severe and often ended fatally, even if the number of ticks feeding was small. The experiments on the two kinds of animals were in agreement in that the severity of the reactions depended on the duration of feeding by the ticks rather than on the number that attached and that infection was passed to the host from the tick during the early stage of engorgement, long before repletion was reached. As the timely removal of the ticks is followed by subsidence of symptoms with recovery and development of immunity, it is concluded that the effects of infection could be eliminated by the use of a system of tick control in which *H. truncatum* was allowed to feed for not less than two and not more than four days. This could be achieved by dipping or spraying every five days or treatment every seven days with an acaricide having a lasting effect of not less than two days.

THEILER (G.). **Zoological Survey of the Union of South Africa. Tick Survey, Part IX. The Distribution of the three South African Hyalommas or Bontpoots.**—*Onderstepoort J. vet. Res.* **27** no. 2 pp. 239–269, 3 col. fldg. maps, refs. Pretoria, 1956.

In this part of a series [*cf. R.A.E.*, B **44** 87, etc.], the distribution in the Union of South Africa of the three species of *Hyalomma* known to occur there is shown on maps, discussed in relation to humidity, temperature, altitude and vegetation and set out in detail in terms of political divisions. The distribution of the ticks in other parts of Africa is summarised. The names recognised for them by Feldman-Mühsam and Hoogstraal are *H. truncatum* Koch (*transiens* Schulze), *H. rufipes* Koch and *H. turanicum* Pom. (*glabrum* Delpy). The author, however, is not quite convinced that the South African *H. glabrum* is identical with *H. turanicum* of Persia and Soviet Central Asia and so uses the former name for her records. The distribution of *H. truncatum* and *H. rufipes* is limited by humidity and that of *H. glabrum* by a combination of humidity and vegetation. *H. truncatum* occurs throughout the western and northern parts of the Union, and is present where the annual rainfall does not exceed 20 ins. Where rainfall is higher, conditions are marginal and the presence of the tick depends on more localised climatic variations and micro-habitats. It occurs in all the drier parts of Africa south of the Sahara. *H. rufipes* occurs throughout the greater part of the Union. It is present in areas with up to 20–25 ins. of rain per year, unless there is winter rainfall or snow, and it can maintain itself in areas with up to 30 ins. where the atmosphere is dry. Little is known of its distribution in central Africa, but it is possibly limited not only to lower rainfall regions but also to areas with only one rainy season per year. Neither dipping nor vegetation types limit the distribution of either species. *H. glabrum* is confined to the Karoo. The critical rainfall range for this species seems to be 10–12 ins. It can exist in marginal vegetational Karooid areas, but only if the rainfall is low enough, and is not likely to be present in any other part of Africa.

FAIRCLOUGH (R.) & THOMSON (W. E. F.). **The Effect of Insecticidal Spraying against *Glossina palpalis fuscipes* Newstead in the Nyando River Basin of Kenya.**—*E. Afr. agric. J.* **23** no. 3 pp. 186–189, 1 map, 5 refs. Nairobi, 1958.

The numbers of *Glossina palpalis fuscipes* Newst. on two tributaries of the Nyando river in Kenya were greatly reduced in 1951–52 by hand-spraying of the vegetation from the river bed with DDT [*R.A.E.*, B **42** 25–26], and an extensive campaign, involving the rest of the river system was carried out in the first half of 1955, when four applications of 5 per cent. DDT in an emulsified solution were made in the same way at intervals of a fortnight or a little longer if the weather was unfavourable. The numbers of *G. p. fuscipes* caught monthly during regular patrols carried out between March 1954 and December 1955 fell from 1,600–2,000 before the spraying began to a maximum of five after the completion of the four applications, but intensive surveys showed that the fly then occurred in the unsprayed upper reaches of the main Nyando river where it had not been found in the original surveys of 1949, and still persisted in parts of the tributaries sprayed in 1951–52, though in much smaller numbers than before the spraying. These infested stretches were sprayed, five times during the last half of 1955 and the first two months of 1956, again as nearly as possible at fortnightly intervals.

Only five flies were caught in the first eight months of 1956 and none between September 1956 and June 1957, although the regular monthly fly rounds were supplemented by intensive surveys in April–June and October–December 1956, and it therefore appeared that extermination had been achieved. The nearest place in which the fly was known to occur was 30 miles away.

The experience gained during the work showed that spraying is best carried out in the drier seasons, because heavy rain washes the insecticide from the leaves and floods may make spraying from the river beds impossible, and also that the flies could be exterminated from inaccessible gorges by spraying at both ends of the gorge, which destroyed them as they left it in search of food. The costs of spraying increased from £42 per river mile in 1951 to £68 in 1955, but compared favourably with that of £300 for hand-clearing. In all, 137 miles of river were treated between 1951 and the end of the campaign.

VAN DEN BERGHE (L.). **Aspect particulier de la trypanosomiase, maladie des pêcheurs, au lac Tumba (Congo belge).**—*Ann. Soc. belge Méd. trop.* **36** no. 2 pp. 185–189. Brussels, 1956. (With a Summary in Flemish.)

The south shores of Lake Tumba, which lies to the south of Coquilhatville in the Belgian Congo, are infested by two tsetse flies, *Glossina tabaniformis* Westw. and *G. palpalis* (*fuscipes*) *fuscipes* Newst. The former occurs on the forest edge near open water, is found all along the shore of the lake and sometimes enters houses. The latter is never seen near dwellings, but occurs in great concentration in the marshy forest areas where rivers enter the lake. Of 200 and 100 adults of *G. p. fuscipes* from one river mouth examined in November 1954, 14 and 5 per cent. were infected with *Trypanosoma gambiense*. The lakeshore population is very sparse, but the local people engage extensively in fishing, for which the neighbourhood of the river mouth is particularly favourable. Sleeping sickness is contracted there and assumes the character of an occupational disease, but its incidence is surprisingly low and the symptoms seem to be mild. It is suggested that the disease may exist in an attenuated form because of the general state of health and nutrition of the population, which is exceptionally high.

van den Berghe (L.) & Lambrecht (F. L.). **Détermination des repas de** *Glossina morsitans*, **West. dans le Mutara (Ruanda).**—*Ann. Soc. belge Méd. trop.* **36** no. 2 pp. 191–196, 11 refs. Brussels, 1956. (With a Summary in Flemish.)

The results are given of examination by the precipitin test of the stomach contents of 61 adults of *Glossina morsitans* Westw. taken in the Kakitumba sector of the region of Mutara (northern Ruanda). This is the first time that such an examination has been made in the Belgian Congo or Ruanda-Urundi. Seven kinds of antisera were used with all the 61 smears and seven others with some of them. The positive reactions indicated that seven of 14 flies had fed on wart-hog (*Phacochoerus aethiopicus*), 16 of the 61 on topi (*Damaliscus korrigum*) [*cf. R.A.E.*, B **46** 167], and none of the 61 on impala (*Aepyceros melampus*), which is the most common antelope in the locality. Thus *G. morsitans* is shown to exercise selection in feeding. Some of the flies had fed on antelopes of three other species or contained zebra or Felid blood, but a comparatively high percentage of positive reactions for man (seven out of 61) is attributed to feeding on the collectors at the time of capture, as the region is practically uninhabited.

van den Berghe (L.) & Lambrecht (F. L.). **Moyens d'action contre les** *Glossina morsitans*, **West. dans le Mutara (Ruanda).**—*Ann. Soc. belge Méd. trop.* **36** no. 2 pp. 197–203, 1 map. Brussels, 1956. (With a Summary in Flemish.)

The types of vegetation with which *Glossina morsitans* Westw. is associated in the wooded savannah of the Kakitumba sector of northern Mutara (Ruanda) were determined by making catches for a year on measured and numbered paths and noting the numbers of flies taken in different hunger stages. Hungry or recently fed flies may have gone to unfavourable country in search of a blood-meal, but the presence of numerous flies with partly digested meals indicates favourable conditions. On the basis of the observations, a method of selective clearing is proposed in which the vegetative cover on a third of the area would be modified but not destroyed. All *Acacia* trees 12 or more feet high would be felled. It is hoped in this way to make northern Mutara safe for stock and to provide a barrier against the advance of sleeping sickness caused by *Trypanosoma rhodesiense*. The cost is discussed.

van den Berghe (L.) & Lambrecht (F. L.). **Notes écologiques et biologiques sur** *G. pallidipes* **dans le Mutara (Ruanda).**—*Ann. Soc. belge Méd. trop.* **36** no. 2 pp. 205–209, 7 refs. Brussels, 1956. (With a Summary in Flemish.)

Glossina pallidipes Aust. was discovered in Mutara (Ruanda) in 1951 and a study of its distribution and habitat was made there in 1954. Three important biotopes for the fly were defined in the north of the region (mixed and dense vegetation along the Kagera and Kakitumba, xerophilous woodland, and dense mixed woodland in comparatively humid ravines), a fourth in thicket, largely of *Euphorbia*, towards the south-west, and a fifth in the east along the river Kagera associated with thickets on termite mounds. In this last, the flies attacked man freely. All the biotopes were characterised by thicket. The presence of *G. pallidipes* raises special difficulties and problems in the campaign against trypanosomiasis of stock and sleeping sickness caused by *Trypanosoma rhodesiense*.

Baker (J. R.) & Robertson (D. H. H.). **An Experiment on the Infectivity to** *Glossina morsitans* **of a Strain of** *Trypanosoma rhodesiense* **and of a Strain of** *T. brucei*, **with some Observations on the Longevity of infected Flies.**—*Ann. trop. Med. Parasit.* **51** no. 2 pp. 121–135, 2 graphs, 26 refs. Liverpool, 1957.

The following is virtually the authors' summary. The two strains of trypanosomes examined (a strain of *Trypanosoma brucei* and one of *T. rhodesiense*, both isolated from *Glossina pallidipes* Aust. in the same district of Uganda) did not differ significantly in their ability to infect *G. morsitans morsitans* Westw. under the conditions of the experiment. Males and females of the fly did not show any significant difference in their ability to support gut infections for seven days or more, or to develop salivary-gland infections with trypanosomes of either strain. Infections by the two trypanosomes did not appear to exert an unfavourable effect on the survival of the flies within the period from seven days after their infective feed until their death. When all the female flies used in the experiment were compared with all the males, the mean life of the females was significantly longer. The results of the experiment suggest that there was a tendency for the greater length of life of some females to be associated with their ability to support salivary-gland infections with trypanosomes. It was not possible to prove such an association statistically. Neither the morphology of the trypanosomes nor the intensity of the parasitaemia in the infecting mammal was obviously related to the subsequent infection rates in the tsetse flies. Examination of the flagellates extruded in the "saliva" of the flies supported the view of Lewis & Langridge [*R.A.E.*, B **38** 47] that all stages of development, excluding the metacyclic trypanosomes, can be produced before invasion of the salivary glands has occurred. Furthermore, the development of infection to the metacyclic stage may be arrested at any of its preceding morphological stages.

Gillett (J. D.). **Age Analysis in the Biting-cycle of the Mosquito** *Taeniorhynchus* (*Mansonioides*) *africanus* **Theobald, based on the Presence of parasitic Mites.**—*Ann. trop. Med. Parasit.* **51** no. 2 pp. 151–158, 3 graphs, 23 refs. Liverpool, 1957.

The following is substantially the author's summary. Analysis of age in mosquitos coming to bite at different times during the biting-cycle is important for epidemiological reasons. Estimates of their age are usually based, apart from general appearance, on the condition of the ovaries, but this entails dissection of each mosquito, and a quicker method would clearly be an advantage. Swamp-breeding mosquitos often harbour the larvae of hydrachnid mites. These parasites, which are very conspicuous, attach themselves to the mosquito as it emerges from the swamp water, and presumably leave it when it returns to lay its eggs. Consequently, most of the mites should be found on young mosquitos coming to bite for the first time.

Observations made during three 24-hour catches on an island at the northern end of Lake Victoria, Uganda, showed an association between the age of females of *Mansonia* (*Taeniorhynchus*) *africana* (Theo.) and their infestation with mites. Not only were the mites almost entirely restricted to mosquitos considered on other grounds to be young, but, when they were present on mosquitos considered to be old, their number per mosquito was always small. It is suggested that the presence or absence of mites may be used as a general indicator of age in this and possibly other swamp-breeding species of mosquito. By the use of this criterion for age, analysis of the three 24-hour catches indicated that young adults made up a constant proportion of the total number of females of *M. africana* coming to bite hour by hour.

HADDOW (A. J.) & GILLETT (J. D.). **Observations on the Oviposition-cycle of** *Aëdes* (*Stegomyia*) *aegypti* **(Linnaeus).**—*Ann. trop. Med. Parasit.* **51** no. 2 pp. 159–169, 4 graphs, 27 refs. Liverpool, 1957.

The following is virtually the authors' summary. Under conditions of almost constant temperature and humidity, but with normally fluctuating daylight, *Aëdes aegypti* (L.) shows a regular cycle of oviposition, with one peak of major activity, which occurs in the afternoon. Under controlled conditions, with constant light, this pattern breaks down and laying becomes aperiodic. Where the hours of light and darkness are artificially reversed (by means of daylight-type fluorescent lamps), the cycle also is reversed. Darkness delays the onset of oviposition. Light is the master factor, and there is a strong suggestion that the peak of oviposition is associated with the onset of light, and, furthermore, that the underlying mechanism may be hormonal.

GILLETT (J. D.) & HADDOW (A. J.). **Laboratory Observations on the Oviposition-cycle in the Mosquito** *Aëdes* (*Stegomyia*) *africanus* **Theobald.** —*Ann. trop. Med. Parasit.* **51** no. 2 pp. 170–174, 2 graphs, 13 refs. Liverpool, 1957.

The following is almost entirely from the authors' summary. Laboratory observations made on the oviposition-cycle of females of *Aëdes africanus* (Theo.) caught in nature near Entebbe, Uganda, and fed on man showed that, under conditions of normally fluctuating 12-hour equatorial day and night, oviposition occurs towards the end of the daylight period. This behaviour is very similar to that found in *A. aegypti* (L.) [see preceding abstract], in which it was shown that, in determining the time of oviposition, light, the main controlling factor, overrides such factors as time of the blood-meal and temperature.

MACDONALD (W. W.). *Aëdes aegypti* **in Malaya. III. Experiments on Control and Eradication.**—*Ann. trop. Med. Parasit.* **51** no. 2 pp. 175–186, 3 graphs, 15 refs. Liverpool, 1957.

The distribution and biology of *Aëdes aegypti* (L.) in Malaya were discussed in the first two papers of this series [*R.A.E.*, B **46** 153–155]. In this third paper, an account is given of experiments on its control that were made in two coastal villages (Jeram and Kapar) in 1954 and the successful application of the results in 1955 in an international seaport (Port

Swettenham), where spraying of houses with DDT had been comparatively ineffective. The results of total spraying (treatment of all inside walls and doors and outside verandahs) and perifocal spraying (treatment of potential breeding places and their surroundings [*cf.* **46** 108]), both with 5 per cent. DDT in emulsified solution, were compared in Jeram. It was found that effective total spraying gives almost complete control for a year or more, and that two perifocal sprayings, at an interval of about six months, are nearly as good. In Kapar village, pellets made of two parts plaster of Paris and one part 50 per cent. DDT dispersible powder [*cf.* **45** 131] were tested. Six introductions of pellets (one pellet, weighing about 3·4 g., per container) over a period of five months into all containers with water reduced the *aegypti* index from 21 to 1 per cent. The pellets had only a slight effect on populations of *A. albopictus* (Skuse) and none on those of *Culex pipiens fatigans* Wied. This is attributed to differences in the natural susceptibility of the larvae to DDT [*cf.* **43** 170] and to the fact that *A. albopictus* and *C. p. fatigans* did not breed exclusively in the treated containers.

The history of a project for the control of *A. aegypti* in Port Swettenham is outlined. About 45 per cent. of the houses in the town are slum-houses [*cf.* **46** 154]. Between September 1952 and October 1954, all the houses in the town had been sprayed at least five times with DDT in emulsified solution at an intended dose of 100 mg. per sq. ft. (doubled for the last application), yet the *aegypti* index was not reduced below about 15 per cent. The possibility that the lack of success was attributable to the development of resistance to DDT in the mosquitos or to failure to spray thoroughly enough is discussed. Larvae collected in March 1955 were a little less susceptible to DDT than those of a laboratory strain, but were still easily killed by it. In 1955, the simpler and cheaper perifocal spraying technique was introduced, and 1 per cent. dieldrin was substituted for DDT. After two sprayings (in June and October–November), the *aegypti* index fell to below 1 per cent., and it was still below that level in June 1956. It is concluded that the perifocal method is the most simple and economical for the control of *A. aegypti* in Malaya, and that eradication is practicable only if a country-wide campaign is undertaken. As the object of perifocal spraying is a quick kill of larvae and females coming to oviposit and there is probably little insecticide remaining after a few weeks, there is less danger of the development of a resistant strain with this method than with total spraying.

HADAWAY (A. B.) & BARLOW (F.). **The Influence of Temperature and Humidity upon the Action of Insecticides. I. During the post-treatment Period.**—*Ann. trop. Med. Parasit.* **51** no. 2 pp. 187–193, 15 refs. Liverpool, 1957. **II. Temperature during the pre-treatment Period.**—*T. c.* pp. 194–200, 10 refs.

The following paragraphs are based on the authors' summaries of these two papers.

Mosquitos (*Aëdes aegypti* (L.) and *Anopheles stephensi* List.) and house-flies (*Musca domestica* L.) were kept at different temperatures and different humidities after topical treatment with kerosene solutions of DDT, γ BHC, dieldrin or diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] and after contact with dry deposits of DDT, γ BHC or dieldrin wettable powders. The toxicity of DDT to the mosquitos and house-flies decreased substantially as the post-treatment temperature increased from 20° to 30°C. [68° to 86°F.], whereas the toxicity of dieldrin and diazinon increased as the post-treatment temperature increased. Temperature had no significant effect on the action of γ BHC, although there was a tendency for kills of house-flies to be higher at higher temperatures. Differences in atmospheric humidity after treatment had no significant effect on the action of any of the insecticides.

Mosquitos (*Aëdes aegypti*) and house-flies were reared and kept at two different temperatures, 25°C. [77°F.] and 30°C. before treatment by topical application of kerosene solutions of DDT or dieldrin and DDT or γ BHC, respectively. At the higher temperature, the mosquito feeding-cycles were shorter and the house-flies oviposited a day earlier. At both temperatures, median lethal doses of the insecticides for female mosquitos varied in a regular manner through successive feeding-cycles, being about twice as high 24 hours after a blood-meal as before it or 48 or 72 hours after it, and those for female house-flies increased with age to a maximum when their nutritional state allowed eggs to be produced in large numbers. Comparison between insects in a similar physiological condition showed that, whereas the post-treatment temperature influenced the action of the insecticides, the pre-treatment temperature had no significant effect on the susceptibility of the insects.

Parker (A. H.). **The Susceptibility of *Aëdes aegypti* Larvae of different Ages to DDT and Dieldrin, and the Relevance of the Results to the Formulation of standardized Susceptibility Tests for Mosquito Larvae.** —*Ann. trop. Med. Parasit.* **51** no. 2 pp. 201–215, 11 refs. Liverpool, 1957.

The following is almost entirely based on the author's summary. The susceptibility of larvae of *Aëdes aegypti* (L.) of different ages to DDT and dieldrin was investigated by exposing them to various concentrations for either one or 24 hours. Both rearing and testing were carried out at 25°C. [77°F.], at which temperature eight days were normally spent in the larval stage. DDT appeared to be much more toxic than dieldrin to fourth-instar larvae when mortality was assessed immediately after a one-hour's exposure, but the reverse was true after a further 24 hours in the normal rearing medium. Thereafter, mortality changed little up to the time of pupation. A 24-hour recovery period was therefore allowed when exposures were for one hour. When exposures were for 24 hours, mortality, as assessed immediately after the exposure, differed only slightly from the readings obtained after a further 24-hour recovery period, and still later readings up to the time of pupation showed little further change. A recovery period therefore did not appear to be very important with exposures of this length.

With one-hour exposures, the age-group displaying the highest susceptibility to DDT and dieldrin was the second-day (first-instar). From then onwards, there was a significant rise in median lethal concentration (LC50) on each successive day of development. The LC50's of DDT and (in brackets) dieldrin, expressed in parts per 100 million, were 0·6 (1·22) for first-day larvae, 0·22 (0·41) for second-day larvae, 0·32 (1·08) for third-day (second-instar) larvae and 30 (7·81) for eighth-day (fourth-instar) larvae. Only fourth-day (third-instar) to eighth-day larvae were tested in the 24-hour exposures, earlier age-groups being subject to a high mortality in the controls. The LC50 of both insecticides rose on each successive day (that of DDT from 0·13 to 2·81 and that of dieldrin from 0·3 to 2·38). Whatever the insecticide or the exposure period, the variation within the fourth instar was invariably greater than that within the third. When exposures were for one hour, the LC50 of dieldrin was significantly higher than that of DDT up to the fifth day (third instar), but from the sixth day (fourth instar) onwards the reverse was true. When exposures were for 24 hours, the

LC50 of dieldrin was the higher up to the sixth day, after which there was no significant difference. The differences may have been due to differences in the physical state of the insecticide as affected by its dilution. The results are discussed in relation to those of other investigators, and their application to the formulation of standardised susceptibility tests for mosquito larvae is considered.

WIRTH (W. W.) & BOTTIMER (L. J.). **A Population Study of the** *Culicoides* **Midges of the Edwards Plateau Region of Texas.**—*Mosq. News* **16** no. 4 pp. 256–266, 10 figs., 10 refs. Albany, N. Y., 1956.

The following is substantially the authors' summary. Four light-traps were operated at regular intervals from June 1953 to June 1954 in ecologically different areas in and near the Edwards Plateau region of western Texas, where the blue-tongue disease of sheep was present [*R.A.E.*, B **42** 147], to compare the prevalence of possible vector species of *Culicoides* in each habitat and to record their relative numbers through a complete annual cycle. Totals of 52,440 individuals and 17 species of *Culicoides* were taken in the four traps during 251 trap-nights of operation. Nearly all the species were numerous from the beginning of warm weather, in early March, until late October. In the three wooded and better watered situations in and near Kerrville, where blue-tongue occurred sparingly, the commonest species were, in fairly close order, *C. haematopotus* Mall., *C. multipunctatus* Mall., *C. arboricola* Root & Hoffman, *C. ousairani* Khalaf, *C. bottimeri* Wirth and *C. crepuscularis* Mall. At the extremely arid Sonora Experiment Station, where blue-tongue was prevalent, *C. variipennis* (Coq.) [*cf. loc. cit.*] outnumbered all the remaining species combined, by nearly 13:1. It was breeding in a sewage effluent seepage area. The average numbers of *Culicoides* and (in brackets) of *C. variipennis* caught per night were 187·2 (1·2) at a poultry yard on the Kerrville Experiment Station, 362·9 (4·2) near a pond on a nearby ranch, 99·3 (0·8) at a residence in the city of Kerrville, and 231·4 (210·2) at the Sonora station.

SAILER (R. I.), MARKS (E. P.) & LIENK (S.). **Notes on** *Culicoides* **in Alaska (Diptera, Heleidae).**—*Mosq. News* **16** no. 4 pp. 270–278, 4 figs., 8 refs. Albany, N. Y., 1956.

A list is given of the six species of *Culicoides* known to occur in Alaska, with a summary of data on the distribution of each of them there, and an account of observations on the genus, mostly made by members of the Alaska Insect Control Project in 1948. Observations were made on two trips along the entire Alaskan highway system in July and in August–September as well as at Anchorage, Valdez and Fairbanks. Adults were seen in landing counts at three out of 173 stations on the first trip and 14 out of 151 on the second. However, most stations were visited between 8 a.m. and 6 p.m., and observations at Valdez indicated that morning and evening periods of activity fell before and after these times. Moreover, some observations were made when wind and temperature were unfavourable and others at too high an altitude (above 2,800 ft.).

The females of *Culicoides* bit aggressively wherever they were found, but never entered houses. The most severe annoyance noted during 1948 was at Valdez [*cf. R.A.E.*, B **40** 100], where a large population of *C. tristriatulus* Hoffman was present in the city and on the tidal flats as early as 18th June. In mid-July 1951, *C. yukonensis* Hoffman was causing annoyance to the residents of Fort Yukon. Most attempts to find breeding places of *C. tristriatulus* were unsuccessful, but they were discovered independently by Williams [*loc. cit.*]. Observations on swarming of males in this species are described and also on adult resting places. The latter suggested that the adults find shelter in almost any dark, moist retreat available. Nearly 90 adults of *C. yukonensis* were taken in June 1948 in an emergence trap set up in a stream near Fairbanks to collect Simuliids, of which thousands were caught. The stream was 1–3 ft. wide and 6–10 ins. deep, with a flow of less than 0·75 ft. per second, and the channel was choked with trailing vegetation. The trap was near the outlet of a shallow, bog-margined lake. W. C. Frohne, working near Anchorage, found that adults of both sexes of *C. yukonensis* emerged in the second half of July and first half of August from saturated sphagnum mat bordering a bog lake and from wet *Carex* marshes. The difference in season of flight is attributed to climatic differences.

SMITH (W. W.) & LOVE (G. J.). **Effects of Drought on the Composition of rural Mosquito Populations as reflected by Light Trap Catches.**—*Mosq. News* **16** no. 4 pp. 279–281. Albany, N. Y., 1956.

The following is virtually the authors' summary. A comparison of light-trap catches of mosquitos was made from the neighbourhood of two permanent pool environments in rural south-western Georgia during the months of August, September and October in a year of normal rainfall (1942) and the sixth of a series of years of drought (1955). An almost complete reversal of species composition was noted. *Anopheles* spp. (chiefly *A. quadrimaculatus* Say and *A. crucians* Wied.) and *Uranotaenia sapphirina* (O.-S.) composed 98·2 per cent. of the catch in the normal year, whereas species of *Aëdes* and *Psorophora*, chiefly *A. vexans* (Mg.), composed 97·8 per cent. of the catch in the drought year. About 80 per cent. more mosquitos were taken per night of trapping in the drought year than in the normal year.

BLAKESLEE (T. E.), NEWSON (H. D.), SAKAI (M.) & TOSHIOKA (S.). **Insemination Rates and Egg Development of Female** *Culex tritaeniorhynchus* **in Nature.**—*Mosq. News* **16** no. 4 pp. 289–291, 1 graph, 3 refs. Albany, N. Y., 1956.

As attempts to establish a colony of *Culex tritaeniorhynchus* Giles in the laboratory in Tokyo had not succeeded in 1955 [*cf.* next abstract], owing to failure to obtain consistent mating and egg production, observations on rates of insemination and ovarian development in nature were made in that year for comparison with the rates obtained in the laboratory. Whereas the insemination rate in laboratory females varied from 0 to 5 per cent. according to the conditions of humidity, temperature and light to which they had been subjected, 97 per cent. of the females collected in nature during a study period of seven weeks (12th August to 27th September) had been inseminated. There was a gradual rise in the rate from 93 per cent. in those collected during the first week to 100 per cent. in those collected in the fifth week. Only 7 per cent. of laboratory-reared females showed any ovarian development, whereas 62 per cent. of those collected in the field did so.

NEWSON (H. D.) & others. **A preliminary Report on the Laboratory Colonization of the Mosquito** *Culex tritaeniorhynchus* **Giles.**—*Mosq. News* **16** no. 4 pp. 282–283. Albany, N. Y., 1956.

A laboratory colony of *Culex tritaeniorhynchus* Giles was successfully established in Tokyo by a method developed during the summer of 1956 [*cf.* preceding abstract] and had been reared through an estimated six generations by the end of October. The colony is housed in a cage 11 ft. long, 8 ft. wide and 8 ft. high. Temperature is kept at 75°F. [*cf. R.A.E.*, B **46** 158] and relative humidity at 80–95 per cent. Both natural and artificial light are used, to a schedule that simulates the dawn and dusk light-intensities recorded in the cage in July and August and provides a total daylight period of over 12 hours. Sucrose, slices of fresh apple, a pig and rabbits are provided as food for the adults. Larvae are reared in aerated tap water containing high-protein food pellets. Oviposition usually takes place at night. Over 15,000 egg-rafts were produced between 22nd June and 22nd October. During the first three weeks of October, an average of over 400 egg-rafts per day were produced, of which about 95 per cent. contained viable eggs. The egg, larval and pupal stages lasted 2, 6 and 2 days, respectively.

WALLIS (R. C.) & LANG (C. A.). **Egg Formation and Oviposition in blood-fed** *Aëdes aegypti* **L.**—*Mosq. News* **16** no. 4 pp. 283–286, 8 refs. Albany, N. Y., 1956.

Laboratory observations were made on blood-fed females of *Aëdes aegypti* (L.) to determine the effect of mating on ovarian development and oviposition [*cf. R.A.E.*, B **46** 175, etc.]. Of 128 virgin females and 46 kept continuously with males and referred to as mated, 55 and 89 per cent., respectively, oviposited within seven days of taking a blood-meal. The average numbers of eggs laid per virgin and mated female in 14 days were 64·9 and 55·6, and the corrected values, obtained by excluding females that laid less than 20 eggs or retained eggs, were 83·1 and 70·5. Spermatozoa were observed in the dissected spermathecae of all but four of the 46 mated females. Three out of 31 of the mated females and 25 out of 88 of the virgin females still contained eggs after 14 days; they had laid 11·3 and 25·8 eggs per female, respectively, and retained 48·3 and 56·1. Ovarian development was arrested at Christophers' stage II [**29** 93] in both virgin and mated females unless a blood-meal was ingested. Rapid ovarian changes occurred on the second and third days after a blood-meal, with development to stage four or five; the only differences noted between virgin and mated females were a slight delay in development in the former until the end of the second day and somewhat less uniform development in them than in the mated group.

It is concluded that mating affects the oviposition response but has little effect on ovarian development and egg formation. Abdominal distension from engorgement with sucrose solution failed to stimulate development such as followed engorgement with blood [*cf.* **46** 153]. Therefore, dissection and examination of the ovaries of females 2–3 days after the administration of a test feed would provide a rapid assay for the presence of an ovarian-stimulating factor in an experimental diet.

HOFFMAN (R. A.) & YATES (W. W.). **Control of Mosquitoes found in Log Ponds in western Oregon.**—*Mosq. News* **16** no. 4 pp. 291–293, 2 refs. Albany, N. Y., 1956.

Several species of pest mosquitos breed in the log ponds of western Oregon, which have increased considerably in number in recent years with the extension of the lumber industry. *Culex tarsalis* Coq., *C. stigmatosoma* Dyar and *Culiseta incidens* (Thoms.) are the chief species, with smaller numbers of *Culex pipiens* L., *C. territans* Wlk. and *Anopheles punctipennis* (Say). The ponds normally support larvae from May to the end of

September, with *C. tarsalis* and *Culiseta incidens* predominating in the spring and early summer and *Culex stigmatosoma* in late summer and autumn, at least in the Corvallis area. Several experiments have been carried out on the control of breeding in the ponds with DDT or EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate]. The test ponds were all less than five acres in area and averaged 6–7 ft. in depth. Water temperatures were 55–60°F. in spring (May–June) and 62–68°F. in September. DDT applied in emulsified solution gave high initial reduction of populations of larvae of *C. tarsalis* and *Culiseta incidens* at 0·04–0·2 parts per million and practical control for about 30 days at 0·1 and 0·2 p.p.m. Wettable-powder treatments were much less effective. Oil solutions gave good initial kill, but reinfestation occurred more rapidly than with the emulsions. On a surface-application basis, as little as 0·25 lb. DDT or EPN per acre in emulsion killed all larvae of *Culex tarsalis*, *C. pipiens* and *Culiseta incidens*, but this dosage would probably be too low in practice, as reinfestation was evident within two weeks. No difference between DDT and EPN was apparent on the basis of 100 per cent. mortality, and similar mortalities (89 and 86 per cent.) were obtained with 0·025 lb. EPN and 0·05 lb. DDT per acre. Because other workers had found EPN to be much more effective than DDT, the possible effect of water temperature or physical or chemical attributes of the pond water were considered. The results of laboratory tests are given in a table. DDT was more effective at 60–70°F. than at 80° in both tap water and log-pond water. EPN was less effective at the lower temperature in tap water but equally effective at the two temperatures in pond water. There were indications of some reduction in the effectiveness of both insecticides in the log-pond water.

Snow (W. E.) & Smith (G. E.). **Observations on** *Anopheles walkeri* **Theobald in the Tennessee Valley.**—*Mosq. News* **16** no. 4 pp. 294–298, 1 fig., 5 refs. Albany, N. Y., 1956.

Records of the occurrence of *Anopheles walkeri* Theo. in the Tennessee Valley are summarised. It breeds in relatively permanent aquatic habitats containing emergent plants as does *A. quadrimaculatus* Say, but the diurnal resting places of the adults of the two species are quite different [*cf. R.A.E.*, B **34** 83], and *A. walkeri* is more widely distributed, occurs in greater numbers and bites man more readily in the Tennessee Valley than is generally supposed. Malaria-control operations have recently eliminated many of its preferred breeding places, but its importance in past years as a pest or possible vector of malaria may have been overlooked because of the absence of the adults from collections taken in barns during routine inspection in summer, although small numbers were found in barns during autumn. In summer, the adults prefer to rest by day on emergent aquatic vegetation [**32** 154]. The presence of the species in the Tennessee Valley was first detected in 1939 by night-biting collections, and it was found to be abundant in the Wheeler Reservoir area in 1947. In an old swamp of tupelo gum [*Nyssa*] largely cleared of trees, the adults were commonly found resting by day just above water level on the stems of lizardtail (*Saururus cernuus*) and waterwillow (*Decodon verticillatus*) and in the tupelo stumps. Night collections appear to give the most reliable index of density and distribution. They may be made by parking a car facing the breeding area at sunset, leaving headlights on for the first five minutes after dark, and then sitting in the car with windows and doors open and interior light on and collecting all mosquitos as they appear. Records so obtained over a period of a year indicated that *A. walkeri* is active well into the autumn and tolerates a considerably wider range of temperature than *A. quadrimaculatus*. Its occurrence in barns in autumn may be related to the killing of swamp vegetation by frost. There was a secondary minor feeding peak at dawn, and some feeding in bright sunlight. Of some 1,900 females caught, marked and released about 1,000 ft. away, 120 were subsequently recovered at the original capture site. The females came to human bait more readily at ground level on the margin of a forest than at heights of 30 or 75 ft. in the trees, and more were taken in a light-trap at the base of a 100-ft. bluff than in one at the top.

BIDLINGMAYER (W. L.) & SCHOOF (H. F.). **Studies on the Viability of Salt-marsh Mosquito Eggs.**—*Mosq. News* **16** no. 4 pp. 298–301. Albany, N. Y., 1956.

The viability of the overwintering eggs of *Aëdes taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.) in samples from salt-marshes near Savannah, Georgia, was estimated in the laboratory in 1953–54 from the numbers of larvae that hatched from samples of equal size. Hatching in winter was induced by keeping the samples at 80°F. for a week and then flooding them, but after the beginning of May the rise in ambient temperature allowed the flooding of the samples without heat treatment.

The numbers of larvae obtained from samples collected in various months from November to April and processed for hatching immediately indicated that there was little or no loss of viability of the eggs under natural conditions, and the numbers from samples collected in January and processed for hatching immediately or after periods of storage in moist or dry soil indicated little loss of viability if flooding occurred in or before May. More delayed flooding, however, resulted in considerable loss of viability by June or July, and complete loss in August, even in samples collected as late as April.

BONNET (D. D.) & CHAPMAN (H.). **The Importance of Mosquito Breeding in Tree Holes with special Reference to the Problem in Tahiti.**—*Mosq. News* **16** no. 4 pp. 301–305, 12 refs. Albany, N. Y., 1956.

The following is partly based on the authors' summary. The problem of mosquito breeding in tree holes is reviewed with particular reference to the control of *Aëdes polynesiensis* Marks, the vector of filariasis [*Wuchereria bancrofti*], in Tahiti. A survey showed that the most important species of tree was the breadfruit (*Artocarpus communis* (*incisa*)), because it is abundant and is usually planted near dwellings, and the agricultural practice of pollarding results in the formation of rot holes. The 27 breadfruit trees in an area of some two acres round two native-style houses were found to have an average of 1·7 rot holes per tree, and 29·6 per cent. of these holes contained larvae of *A. polynesiensis*. Methods used to control breeding in tree holes include filling and cementing the holes, which is impracticable in rural areas, application of larvicides, which is of limited value because of its impermanence, and the introduction of species of *Toxorhynchites*, the larvae of which are predacious on those of other tree-hole mosquito larvae [*cf. R.A.E.*, B **40** 3–4]. A colony of *T. brevipalpis* Theo. was established in Tahiti soon after its introduction into Hawaii [**41** 77–78], but the release of over 3,500 larvae and adults did not result in its recovery in the field. A recently devised method that is simple and relatively permanent consists in partly filling the tree hole with dirt or gravel and placing a fern, preferably a species of *Asplenium*, on the top. Nine months after treatment of a series of infested tree holes in this way in Tahiti, the ferns were found to be growing actively, and the holes contained no water or larvae.

POSTIGLIONE (M.) & VENKAT RAO (V.). **Malaria in Burma. A Review.**—*Indian J. Malar.* **10** no. 4 pp. 273–298, 2 maps, 50 refs. Kanpur, 1956.

The following is substantially the authors' summary. The malaria situation in Burma, as it was known about 1951, is reviewed in the light of the information available, which is mostly in the form of unpublished records. In the Hill Tracts, which comprise about 60 per cent. of the country, malaria is hyperendemic. Transmission occurs almost throughout the year, but there are peaks in April–May and September–October (the beginning and end of the monsoon period), the second being the higher. The winter months are markedly healthier. *Plasmodium falciparum*, *P. vivax* and *P. malariae* are all present. The main vector is *Anopheles minimus* Theo. [*cf. R.A.E.*, B **36** 204; **37** 95], but *A. leucosphyrus* Dön. is also an important vector in the thickly wooded parts of the northern hill range [*cf.* **38** 201].

The Plains Region (the dry zone of central Burma bounded on the south by the Delta Region) is divided into three areas for an assessment of malaria. The disease is hyperendemic in foot-hill areas and is nearly so in irrigated areas, while the unirrigated areas are free from endemic malaria but are subject to periodical epidemics, which may also occur in the irrigated areas and are associated with both heavy and short monsoon rains. The transmission season extends from July to March, with a peak in the post-monsoon months (December–January). *A. minimus* is the undoubted vector in foot-hill areas, but the vector in the other areas has not been definitely established. One gland infection has been observed in *A. culicifacies* Giles.

A large part of the Delta Region is generally free from malaria. The disease is hyperendemic only in the Pegu Hill range, which is sparsely populated. Localised epidemics have occurred in this region at somewhat irregular intervals, and they are associated with the failure of the monsoons. The mosquito responsible for them is not definitely known. Gland infections were found in *A. maculatus* Theo. in 1929.

The coastal region, extending from Arakan to the tip of Tenasserim and including the coastal strip of the Delta, is generally an area of hyperendemic malaria. *A. minimus* is the vector in the montane and submontane areas, and *A. jeyporiensis* James (which may possibly be represented by var. *candidiensis* Koidz.) is also involved towards the Arakan border in the north [*cf.* **40** 210]. *A. leucosphyrus* has recently been found in Moulmein, and it may also take part in transmission, at least in that area. The main vector on the coast appears to be *A. annularis* Wulp. *A. sundaicus* (Rdnw.) is present in fair numbers in the Arakan, and occurs in other coastal areas, but dissections have so far been negative. The bionomics of the various vectors are briefly discussed.

JASWANT SINGH, KRISHNASWAMI (A. K.) & RAGHAVAN (N. G. S.). **Filariasis in Travancore-Cochin State. II. Shertallai Taluk.**—*Indian J. Malar.* **10** no. 4 pp. 317–325, 2 graphs, 1 map, 2 refs. Kanpur, 1956.

Shertallai Taluk in the State of Kerala (Travancore-Cochin) is a rural, coconut-growing area, with many ponds used for watering the coconuts and retting the fibres. In the course of a filariasis survey of the taluk made in March–May 1955, endemicity and microfilaria rates of 42·9 and 20·9 per cent., respectively, were found among the 8,463 people examined (3·3 per cent. of the population). Nearly all the infections were with *Wuchereria malayi*, but 16 cases of infection with *W. bancrofti* were also recorded from Shertallai Town, where this species has begun to establish itself with advancing urbanisation. Mosquitos of 13 species, including three of the genus *Mansonia*, were collected and dissected, but developing filariae were found only in 92 of 1,830 females of *M. annulifera* (Theo.) and 1 of 62 of *M. uniformis* (Theo.). These mosquitos bred principally in ponds containing *Pistia stratiotes*, especially those in which coconut husks were allowed to rot. Disease, microfilaria and endemicity rates in various localities in the present survey are compared with those recorded by Iyengar in 1938 [*R.A.E.*, B **27** 44]. Except in two localities in which there was a considerable fall, the rates have remained practically unchanged.

DIKSHIT (P. K.), MOHAN (B. N.) & JOSHI (J. G.). **Increased Citric Acid Content in resistant** *Culex fatigans*.—*Indian J. Malar.* **10** no. 4 pp. 327–330, 12 refs. Kanpur, 1956.

As it was thought that energy-furnishing metabolic reactions might be accelerated in insects that had developed resistance to insecticides, and that this would result in an increased formation and probably accumulation of certain intermediate metabolites such as citric acid, the citric-acid contents of larvae, pupae and adults of a normal strain of *Culex pipiens fatigans* Wied. were compared with those of a strain that had developed a high level of resistance to DDT by selection in the adult stage only over 50–52 generations. The resistant strain showed resistance in the larval stage also. The adults were killed with chloroform and the larvae and pupae with warm water (50°C. [122°F.]), and the samples were then dried in an air oven at 70°C. [158°F.] for 2–3 hours and the citric-acid content determined. The mean amounts per adult, pupa and larva were 45, 26 and 52 per cent. greater in the resistant than in the normal strain. The observations were based on 165–330 adults, pupae or larvae of each strain. The eggs of the resistant strain also contained more citric acid than those of the normal strain but the numbers studied were small.

MISRA (B. G.). **Malaria in North-east Frontier Agency (India).**—*Indian J. Malar.* **10** no. 4 pp. 331–347, 1 map, 17 refs. Kanpur, 1956.

The North-East Frontier Agency is a hilly tract in north-eastern India with an area of about 34,000 sq. miles and a native population of about 800,000 in all and 100,000 in the foot-hills, where malaria is hyperendemic. The climate is hot and humid, except during the short winter (December and January) and the rains continue from March to October, with a peak in July. Morbidity figures indicated that malaria occurs throughout the year, but is most prevalent in September and October and least so in December and January.

A survey to determine the distribution of the disease and the identity of its vectors was made between 28th November 1955 and 14th January 1956. The spleen rate in 877 children 2–10 years old in the 35 villages surveyed averaged 67·2 per cent. and varied from 26·6 to 100 per cent. in the foot-hills but was only 2·6 per cent. in one village at 3,000 ft. The parasite rate amongst the same children averaged 17·7 per cent. and was 81·8 per cent. in one village. The parasite rate in infants in 28 villages ranged from 23 to 83 per cent. *Plasmodium falciparum* was the predominant parasite, but *P. vivax* and *P. malariae* were also present. Mosquitos were collected in dwellings in almost all the villages visited for the spleen and parasite surveys, and their density was found to be very low. The females of *Anopheles* taken comprised 21 of *A. maculatus* Theo., 16 of *A. aconitus* Dön., seven of *A. minimus* Theo., six of *A. vagus* Dön. and one each of *A. annularis* Wulp and *A. pallidus* Theo. All were dissected, and a gut and gland infection were found in one female of *A. minimus*. The only possible breeding places were perennial streams. The malaria problem in the Agency is seen to be one of endemicity in the foot-hills and imported infection in the high hills due to the migratory habits of the people. The measures recommended are spraying of houses in the foot-hills three times a year for two years and on the high hills once with 200 mg. DDT per sq. ft., suppressive treatment with drugs and care to avoid the creation of mosquito breeding places.

SHAMA SASTRY (H.), SITARAMAN (N. L.) & RAMA RAO (T. S.). **Effect of Insecticides on Vector Species and Development of Resistance, if any, in different Vector Species in Hiriyur Area, Mysore State.**—*Indian J. Malar.* **10** no. 4 pp. 349–356, 1 graph, 4 refs. Kanpur, 1956.

As part of an investigation designed to determine whether malaria vectors in various parts of India in which insecticide deposits have been used continuously for at least four years are developing resistance to the insecticides, an experiment was made in the Hiriyur area of Mysore State, where the main vectors are *Anopheles culicifacies* Giles and *A. fluviatilis* James, and *A. stephensi* List. may play a minor part [*R.A.E.*, B **23** 17]. Between 1951 and June 1955, the area had been sprayed nine times with DDT at 100 mg. per sq. ft. From seven to twelve months after the last DDT treatment, Anophelines were caught in four villages and exposed for one hour to filter paper treated with a 2, 1 or 0·5 per cent. DDT solution or solvent alone. The mortality percentages in 24 hours in the batches exposed to the three concentrations of DDT and (in brackets) their controls were 100 (100), 97·2 (91·7) and 100 (100) for *A. culicifacies*, 100 (100), 100 (91·7) and 100 (100) for *A. fluviatilis* and 72·2 (33·3), 72·2 (60) and 69·4 (58·3) for *A. stephensi*. The authors conclude that the three species are still highly susceptible to DDT and attribute the mortality among the controls to the fact that the mosquitos were collected from sprayed villages.

MACDONALD (G.). **Theory of the Eradication of Malaria.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 369–387, 2 graphs, 19 refs. Geneva, 1956. (With a Summary in French.)

The following is the author's synopsis. The natural disappearance of malaria from certain areas, a phenomenon which has for many years been observed in various parts of the world, is discussed in relation to the recent deliberate elimination of the disease from large tracts of land. The process of elimination, the detection of residual foci, and the ways in which the disease may be reintroduced into a country are outlined briefly, and the course of events in epidemics which arise from small origins is described in detail. The factors affecting the basic reproduction rate [*cf. R.A.E.*, B **42** 82] in such epidemics (mean duration of infectivity of a primary malaria case, density of mosquitos in relation to man, and longevity and degree of anthropophilism of the vector concerned) are analysed and a simplified method of expressing this rate mathematically is given in an annex.

BUSVINE (J. R.). **The Significance of Insecticide-resistant Strains with special Reference to Pests of medical Importance.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 389–401, 32 refs. Geneva, 1956. (With a Summary in French.)

The meaning of insecticide resistance and the way in which it should be detected and measured are discussed, and examples are given from recent data of measurements of resistance in adults or larvae of mosquitos of different species in various parts of the world. In addition to the results noticed elsewhere [*R.A.E.*, B **44** 164; **45** 14; **46** 109], estimates of resistance in adult Anophelines obtained by the standard Busvine (WHO) method, which is virtually the same as that of Busvine & Nash [**41** 156], are given for *Anopheles maculipennis sacharovi* Favr in Greece [*cf.* **45** 109–110] and the Lebanon, *A. sundaicus* (Rdnw.) in Java [*cf.* **44** 163; **46** 214] and *A. stephensi* List. in Saudi Arabia. The median lethal percentage concentrations (LC50's) of DDT for *A. m. sacharovi* were 1·2 and 2·6 in 1954 in Agoulinitsa and Scala, $>$ 3 in 1955 in Scala and 1·7 in 1955 in the Lebanon. The LC50 of dieldrin in Scala in 1955 was $>$ 1. Normal susceptibility is unknown. The LC50's of DDT, dieldrin, γ BHC and aldrin, as determined by Davidson in DDT-sprayed and (in brackets) unsprayed areas were 9 (0·5), 0·08 (0·065), 0·0085 (0·008), and 0·4 (0·37) for *A. sundaicus*, and 5 ($<$ 0·5), 0·17 ($<$ 0·1), 0·013 ($<$ 0·05) and 0·5 ($<$ 0·2) for *A. stephensi*. A speculative discussion follows on the way in which insecticide resistance arises, whether it can be prevented or overcome, its importance in the past and at present, and finally its future.

Livadas (G. A.) & Thymakis (K.). **Susceptibility of Malaria Vectors to DDT in Greece. Laboratory Findings.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 403–413, 1 map, 10 refs. Geneva, 1956. (With a Summary in French.)

Belios (G. D.) & Fameliaris (G.). **Resistance of Anopheline Larvae to Chlordane and Dieldrin. Field and Laboratory Tests on** *Anopheles sacharovi*.—*T. c.* pp. 415–423, 1 map, 10 refs. (With a Summary in French.)

The first paper contains detailed results of laboratory experiments made in Greece in 1953 and 1954 and in Crete in 1954, the salient features of which have been noticed from a briefer source [*R.A.E.*, B **45** 110].

The following is almost entirely based on the authors' summary of the second paper. DDT at a concentration of 0·1 per cent. in emulsified solution has been regularly used in Greece as an Anopheline larvicide since 1947. Chlordane and dieldrin were used in some districts in 1955 and more generally in 1956. Field tests had shown that 20–40 mg. technical DDT or chlordane or 7–14 mg. dieldrin per sq. metre would cause 96–100 per cent. mortality. Results were good until 1956, when it was reported that chlordane and dieldrin had lost their effectiveness in the Astros area (Arcadia District). By August, failure of chlordane used at the customary dosage had also been reported in several districts of the Peloponnese, Macedonia, the Ionian Islands and Epirus.

Extensive anti-malaria measures have been used in the Astros area since 1946. Until 1950, houses in all the villages were treated with DDT, and four large villages came within the zone of a larvicide programme. The larvicides used were paris green and DDT in 1947, DDT from 1948 to 1954, chlordane in 1955, and chlordane and dieldrin in 1956. Large expanses of swamp were sprayed from aircraft with DDT from 1946 to 1950. Resistance in adults of *Anopheles maculipennis sacharovi* Favr was suspected in 1952 [*cf.* **42** 32, 54, 140] and confirmed in 1953 [*cf.* **45** 109].

Experiments in the field in 1956 showed that the larvae of this mosquito had acquired an appreciable resistance to chlordane and dieldrin, their density being practically the same in treated and control areas, but showed unimpaired susceptibility to DDT. These conclusions were confirmed by laboratory tests in which fourth-instar larvae were put in batches of 25, in 20 ml. of the swamp water in which they were collected, into enamel pans containing the insecticide in 180 ml. distilled water. The results, which are given in tables, indicate that the concentrations in parts per million required to kill over 90 per cent. of the larvae are about 0·5 for DDT, 6–8 for chlordane and 20–25 for dieldrin. In a further test, dieldrin was somewhat more effective in swamp water (with a chloride content of 10·25 per mille) than in distilled water, but far less effective than DDT in either.

Frizzi (G.) & Holstein (M.). **Étude cytogénétique d'***Anopheles gambiae*.—*Bull. World Hlth Org.* **15** no. 3–5 pp. 425–435, 10 figs. Geneva, 1956. (With a Summary in English.)

The following is the authors' summary. In order to facilitate the study of natural populations of *Anopheles gambiae* Giles, the authors have prepared a chromosome map of that mosquito, and note a very variable chromosome structure. Indeed, cytogenetic studies show that *A. gambiae* has the most highly polymorphic chromosome structure yet observed in any Anopheline [*cf. R.A.E.*, B **41** 30; **43** 98], and it seems very possible that the considerable differences in the behaviour of this mosquito observed in a number of regions of Africa may be due to genetic differences shown by this polymorphism. A comparative study of two lots of larvae hatched from the same subcolony of eggs but developed, the one at 31°C. [87·8°F.] and the other at 24°C. [75·2°F.], has also confirmed the existence of differentiated *gambiae* populations with correspondingly different frequencies of heterozygote inversion.

Gillies (M. T.). **The Problem of Exophily in** *Anopheles gambiae*.—*Bull. World Hlth Org.* **15** no. 3–5 pp. 437–449, 16 refs. Geneva, 1956. (With a Summary in French.)

In recent years, increasing attention has been paid to the occurrence of outside-resting populations of Anophelines in many parts of the world. An account is given of work on the subject in Tanganyika, and the problem in relation to *Anopheles gambiae* Giles throughout Africa is discussed. To determine the type of exophily involved, it is necessary to know at what stage of the gonotrophic cycle the females are found outside, whether the preferred host is under shelter at the time when most of the mosquitos are feeding, whether there are houses or animal shelters suitable to be used as resting places in the daytime, and, if feeding takes place outside, whether they are adjacent to the nocturnal habitat of the host. The author considers that the concept of opportunity as a factor influencing the mosquito's choice of resting site needs to be emphasised. On this basis, he recognises three kinds of exophily. It may be obligatory, where no houses exist in an area, as is the case with *A. culicifacies* Giles in uninhabited jungle in Ceylon, facultative, where one of the preferred hosts is outside but human or animal shelters are plentiful in the neighbourhood, as in the case of *A. gambiae* in the South Pare district of Tanganyika [see below], or deliberate. Mosquitos showing deliberate exophily may be of type A (endophagous of Senior-White [*R.A.E.*, B **43** 124]), feeding indoors but leaving the shelter for natural harbourages before daylight (*A. maculatus* Theo. in Malaya [**41** 162] and *A. aquasalis* Curry in the West Indies), or type B (exophagous of Senior-White), feeding mainly out of doors and seldom using houses as resting sites even when they are available (*A. coustani* Lav. *sens. lat.* and *A. pharoensis* Theo.). The significance of the finding outside of females in the different stages of the gonotrophic cycle and of males is indicated.

Outdoor-resting populations of *A. gambiae* have been studied in two areas of Tanganyika and very distinct findings obtained. In a humid region in the sub-coastal belt, catches were scanty and largely composed of unfed and gravid females [**42** 119], showing that exophily when it existed was deliberate. In the arid thorn-bush country of South Pare district, mosquitos were caught resting outside in large numbers, and many were recently fed. The different findings were attributed chiefly to the presence of large herds of cattle kept outside at night in thorn enclosures in the latter area and their absence from the former, and also to the greater Anopheline population in South Pare district and the paucity of resting sites. Exophily was facultative. Reports of exophily in *A. gambiae* in other parts of Africa are also analysed. They indicate that partial exophily (exophily in the second half of the gonotrophic cycle) is a characteristic of the species over much of its range, but show that there is great variation in its behaviour in different regions. Some of the variation can be explained in terms of differences in environment, particularly in the availability at night of different hosts, but some may be genetically determined [**41** 115–116]. It is suggested that the existence and nature of distinct populations with the behaviour differences described should be examined, and that the mosquitos that survive as exophilous populations in areas in which systematic house-spraying is in operation should be studied in detail [*cf.* **43** 173].

GILLIES (M. T.). **A new Character for the Recognition of nulliparous Females of** *Anopheles gambiae.—Bull. World Hlth Org.* **15** no. 3–5 pp. 451–459, 4 figs., 3 refs. Geneva, 1956. (With a Summary in French.)

A solid translucent plug, probably secreted by the male, has been found to occupy and distend the oviduct of recently inseminated wild-caught or laboratory-bred females of *Anopheles gambiae* Giles. Except for one in an unfed female, these plugs have been seen in nature only in recently engorged females with ovaries in Christophers' stage II or III [*R.A.E.*, B **29** 93]. The plugs were absorbed within 36 hours of insemination and were never found in virgin females. Double plugs were sometimes seen in caged females but never in nature. Somewhat similar formations were found in *A. longipalpis* (Theo.) and *A. funestus* Giles, though those in the latter were more difficult to detect on dissection. They were not found in several other species of *Anopheles* examined. This is thought to be the first time that the plugs have been described in mosquitos, but analogous formations are known in Lepidoptera, Orthoptera and bees.

The presence of the plug makes it possible to recognise one section of nulliparous females, those that have been recently inseminated, in a wild-caught, recently fed population of *A. gambiae*. Those that are not inseminated are also clearly nulliparous. The fact that inseminated females without plugs may be nulliparae in which the plugs have been reabsorbed prevents the exact determination of the number of nulliparous females in a recently fed population by dissection and examination, but the method makes it possible to compare the age structure of two populations collected in different circumstances, for example, before and after spraying. Among recently engorged females taken in outside shelters before and after houses were sprayed with dieldrin in the South Pare district of Tanganyika, young females were found to be twice as numerous after spraying as before it, the main increase being in those with plugs. The technique of dissecting and examining the mosquitos and a useful way of recording the results are described.

GIGLIOLI (G.). **Biological Variations in *Anopheles darlingi* and *Anopheles gambiae*. Their Effect on practical Malaria Control in the Neotropical Region.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 461–471, 30 refs. Geneva, 1956. (With a Summary in French.)

The following is substantially the author's summary. A remarkable range of variation has been demonstrated in the biting habits of *Anopheles darlingi* Root in South America, where it is the most dangerous and widespread vector of malaria. At the centre of its area of distribution, on the central plateau of Brazil, it includes both individuals that are anthropo-endophilous and others that are zoo-exophilous. The use of DDT has made it possible to control malaria and eliminate *A. darlingi* inside dwellings, but the species persists in large numbers outside [*cf. R.A.E.*, B **39** 114–115; **41** 57]. Its anthropophilous tendencies increase progressively towards the periphery of its range. In parts of British Guiana and north-central Venezuela, it is so closely associated with man that it has been eradicated by house-spraying with DDT as the only measure [*cf.* **44** 26, 27]. Conditions of travel and migration of man, imposed by the South American rain forest, have probably favoured the development of a specialised anthropophilous strain on a geographical pattern. There is ample evidence of a similar strain evolution in *A. gambiae* Giles, but on a more confused pattern [*cf.* **18** 199; **43** 6, 173, etc.]. *Aëdes aegypti* (L.) also presents an outstanding example of variation in biting habits [**33** 189]. A proper understanding of the extent and significance of anthropophilous and zoophilous tendencies is essential for the proper conduct of malaria control campaigns, for the formulation of long-term policies and for the proper evaluation of the risks of resistance to insecticides. A high degree of domesticity in a vector species does not exclude the existence of a zoophilous strain in the same locality. In preliminary malaria surveys, the zoophilous tendencies of the vector should always be examined and evaluated.

WEITZ (B.). **Identification of Blood Meals of Blood-sucking Arthropods.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 473–490, 1 fig., 14 refs. Geneva, 1956. (With a Summary in French.)

Tests for identifying the blood-meals of arthropods must be sensitive enough to detect the presence and nature of even partly digested blood and specific enough to indicate the species of animal from which it comes. The stomach contents often include only a small amount of identifiable protein and this for a very short time. It is difficult to catch insects immediately after they have fed, particularly those that rest outside. Environment affects the rate of digestion [*R.A.E.*, B **41** 209], and the rate differs greatly in *Glossina* according to whether or not the fly is in captivity [*cf.* **41** 210], but there is no evidence that this applies among less specialised insects such as mosquitos. Generally, mosquitos should be caught within 24 hours of feeding to be sure of the validity of the results.

Methods of examination mentioned in the literature fall into two types, one founded on the examination of cellular elements in the blood-meal and the other on the specificity of the serum proteins. Direct examination of the red blood cells allows the separation of avian, reptilian and mammalian blood with fair certainty, but the differentiation of various kinds of mammalian blood is only approximate. Other techniques use immunological reactions of blood corpuscles, but in general, examination of blood cells is not recommended as they deteriorate rapidly and may be distorted during digestion. The technique of preference is the precipitin test, which is based on the specific combination of the serum proteins of the blood. It depends on the interaction of saline extract of the blood-meal and a suitable antiserum, usually prepared from rabbits. The technique of the test is described. It includes the collection of the meal and its fixation on filter paper, the addition of saline, the preparation of antisera, and standardisation and absorption of antisera giving cross-reactions. If it is necessary to differentiate blood-meals from closely related hosts, as it is in the case of *Glossina*, the somewhat elaborate inhibition test must be used in the final stages [*cf.* **44** 3; **46** 167], as the precipitin test is not sufficiently sensitive. The inhibition test is based on the specific inhibition by the blood-meal, under specified conditions, of the agglutination of tanned and sensitised red blood cells caused by an antiserum prepared against the protein with which the red blood cells have been sensitised. If the range of suspected animals is large, it is necessary to economise material by first screening the blood-meals for the most likely hosts. A description is given of the procedure of successive precipitin and inhibition tests usually adopted for identification of blood-meals of *Glossina*, which serves as an example of the most elaborate procedure likely to be required.

Chwatt (L. J. Bruce-). **Radioisotopes for Research on and Control of Mosquitos.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 491–511, 1 fig., 42 refs. Geneva, 1956. (With a Summary in French.)

Some basic data on the physics of radioactive isotopes are summarised, and ways in which they have been used in entomological research are reviewed, with particular reference to aspects that have a bearing on problems of Anopheline control. One of the chief applications is in the study of ecological problems that it has not been possible to solve by other means. Larvae of *Aëdes aegypti* (L.), particularly those in the last two instars, readily absorb radiophosphorus [*R.A.E.*, B **40** 105] and radiostrontium (^{89}Sr) when immersed in a radioactive bath, and the use of baths containing 2·5–5 mμc. per ml. per larva of either isotope has been found to result in radioactivity of 1–5 mμc. in the adult, a satisfactory level for marking purposes. The half-lives of ^{32}P and ^{89}Sr are 14·3 and 54 days; this latter is therefore preferable because of its slower rate of decay. The author recently found 15–20 mμc. ^{32}P per ml. in the larval bath to give adults with a radioactivity of 1–2 mμc., which is much less than the levels obtained by others with lower concentrations. Disparity of results is attributed to the fact that the density of the larvae and the amount of their food (which absorbs much of the radioactivity) were not standardised. The flight ranges of various mosquitos have been determined by the use of tracers, and J. C. Bugher & M. Taylor report the recovery of *A. aegypti* in Nigeria for distances up to 0·75 mile. Other methods used to introduce radioactive elements into living organisms are incorporation of the elements in the food of insects [**39** 135, 168, 181], and immersion of plant stems in a solution of the tracer, a technique that was used to investigate the feeding preferences of *A. communis* (Deg.) on flowers [**41** 23], while insects that have fed on radioactive mosquito larvae have been identified by their radioactivity. Reference is made to observations on physiology and the biological effects of radiation and the employment of tracers in the study of insecticides and their action. The use of ^{36}Cl and ^{14}C allows of the more accurate estimation of the γ isomer in BHC than any other method. A promising use of tracers is for the determination of the area of dispersal of aerosols dispensed from aircraft by means of isotopes with strong radiation incorporated into the insecticides.

Hamon (J.), Adam (J. P.) & Grjebine (A.). **Observations sur la répartition et le comportement des anophèles de l'Afrique équatoriale française, du Cameroun et de l'Afrique occidentale.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 549–591, 8 graphs, 3 maps (1 fldg.), 15 refs. Geneva, 1956. (With a Summary in English.)

The following is almost entirely from the authors' summary. In this study of the Anopheline populations of French Africa south of the Sahara and neighbouring territories, the authors review their own investigations and report observations communicated to them by others. The geographical distribution of the various species of *Anopheles* is summarised in a table and given in more detail in maps of West Africa, the French Cameroons and French Equatorial Africa. The biology and behaviour of each species are dealt with separately and, in the case of the most important ones (*Anopheles gambiae* Giles and *A. funestus* Giles), the breeding places in different ecological areas are described and accounts are given of variations in the larval and adult populations before, during and after the rainy season, trophic preferences and resting places, maxillary indices, feeding places and aggressiveness, sporozoite rates, proportion of uniparous and multiparous females, the parts played by the two species in the transmission of malaria and their reactions to treatment of dwellings with insecticides.

The explanations given by the authors for certain peculiarities of behaviour differ from those proposed previously. Thus, in the case of *A. gambiae* in the Sudan savannah of Haute-Volta, they consider that the lag between the onset of the rainy season and the increase in the number of adults is not due to the fact that the hibernating (dry-season) females need a relative humidity of 80 per cent. for oviposition [*cf. R.A.E.*, B **41** 115], since larvae are found throughout the year and this indicates that oviposition takes place even in the middle of the dry season. It is the authors' opinion that the rains kill many females that have their resting places in the open and that the drying up of a large proportion of breeding places in which surviving females have laid their eggs prevents the larvae from developing completely. Moreover, the fluctuations of populations of *A. gambiae* and *A. funestus* in relation to rainfall differed from those observed by Holstein [*loc. cit.*], because marshes or rice-fields in which *A. funestus* bred during the rains provided breeding places for *A. gambiae* as they dried up. Variations in the density of all females per hut, on the one hand, and in the density of uniparous and multiparous females alone, on the other, generally had the same trend, but the maxima of the two groups did not coincide. The difference was particularly marked in the case of *A. funestus*. Furthermore, there was no clear correlation in either species between the percentage of uniparous and multiparous females and the sporozoite rate, probably because the uniparous females cannot be infected with sporozoites. Consequently, care should be taken in using the absolute density per hut, since this figure may be based almost solely on nulliparous and uniparous females, which play no part in transmission.

A. gambiae is the most dangerous vector of malaria in West and Equatorial Africa because of its considerable powers of adaptation. It is by far the dominant species in urban malaria, since its breeding places are linked in large part with human activities. *A. funestus* plays a considerable part, but the extent of this depends on its frequency in relation to that of *A. gambiae*, which shows appreciably higher sporozoite rates, although its period of transmission is more limited. In the Niayes area in Senegal, 90 per cent. of the Anophelines caught in dwellings during ten months of the year are *A. funestus*. In Chad, the percentage of females of *A. funestus* collected in the dwellings at Fort Lamy amounted to only 8 per cent., as against 60 per cent. of *A. gambiae* and 30 per cent. of *A. pharoensis* Theo. The importance as vectors of species other than *A. gambiae* and *A. funestus* may be either lessened or increased by certain biological characteristics. For example, it is difficult to define the importance of *A. pharoensis* in which the sporozoite rate is always low, but often compensated by the extraordinary abundance of the species. It would, however, not be easy to exterminate *A. pharoensis*, as it is protected from hut treatment by its semi-exophilous nature and its habit of biting in the open, while its flight range makes the control of breeding places almost impossible. The authors draw attention to the part of relay vector played by certain mosquitos of secondary or local importance.

GRJEBINE (A.). **Aperçu sommaire du peuplement anophélien de Madagascar.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 593–611, 2 maps, 36 refs. Geneva, 1956. (With a Summary in English.)

The following is almost entirely based on the author's summary. A list is given of 26 species of *Anopheles*, four of them represented by two varieties, that were known to occur in Madagascar in 1955. Of these, 11 species (one with two varieties) are not known elsewhere and the others are African, but the native ones do not include *A. funestus* var. *imerinensis* Monier & Treillard, which has not been found in Madagascar since its description [*R.A.E.*, B **23** 271] or in any museum collection in France. All the native species were found in the coastal areas and on the eastern slopes of the High Plateaux, and their breeding places were generally natural ones, not modified by human agency. Two of them, *A. fuscicolor* van Som. and *A. pauliani* Grjebine, bite man [*cf.* **43** 136], and the former may be endophilous. In Madagascar, both man and cattle are hosts of the African species, and the close association between the two has given rise to more or less marked anthropophily or zoophily, varying according to the species and the geographic region. In the east, where the relatively few cattle are kept in sheds far away from human dwellings, *A. gambiae* Giles and *A. funestus* Giles show pronounced anthropophily. In the west, on the other hand, with its scattered population and large herds, a very marked zoophilous tendency and an attenuated form of malaria have developed, despite an exceedingly high Anopheline density (500 females of *A. funestus* to every ten huts). The Anopheline population of the High Plateaux is, and is likely to remain, poor in species, and the southern region, which is of a subdesert nature, is unfavourable for Anophelines, but the fauna is rich and varied in the Sambirano region and the northern region, which are hot and humid.

A description is given of the characteristics of Anopheline breeding places in Madagascar, among which rice-fields are important because of their changing nature from month to month, and data on the distribution and biology of the species that tend to bite man and particularly those that may be vectors of malaria are reviewed. It is pointed out, however, that the gametocyte rate has become extremely low as a result of chemoprophylaxis and mosquito control covering almost the whole island. Dissections of *A. gambiae*, *A. funestus*, *A. marshallii* (Theo.) and *A. squamosus* Theo. caught on the east coast, in the west and in the Tananarive area were all negative, and even in 1937 Monier found only one sporozoite infection in *A. gambiae* and two in *A. funestus*, out of 4,632 dissections.

A. gambiae occurs throughout the island, but rural activities, particularly rice-growing, have a marked influence on its abundance. In general, it has a tendency to become exophilous and negatively phototropic after DDT treatment [*cf.* **43** 137]. Its zoophily becomes clearly apparent when the cattle sheds, which are always less well treated with DDT than the huts, are situated near dwellings. In such cases, malaria control operations give spectacular results. On the other hand, when the cattle are few and kept outside the villages, endophily and anthropophily are maintained at least during the rice-growing period, when most of the peasants live among the rice-fields in simple shelters that are insufficiently treated with DDT or not treated at all. In these areas, bi-weekly chemoprophylaxis might improve the situation.

A. funestus is the second most important potential vector. It is predominantly zoophilous where it has a choice between man and cattle, but its density in the native huts is high, above all in the west. There have been various records of its presence on the High Plateaux [*cf.* **26** 207], but it is possible that these were due to misidentification, as investigations carried out by the author and others indicate that *A. marshallii* is the vector found in this region, and that *A. funestus* is absent [*cf.* **43** 137].

Macdonald (G.). **Epidemiological Basis of Malaria Control.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 613–626, 20 refs. Geneva, 1956. (With a Summary in French.)

The following is virtually the author's synopsis. The epidemiology of malaria is discussed with special reference to the pattern observed in equatorial Africa, where the principal vectors are *Anopheles gambiae* Giles and *A. funestus* Giles and where the disease is very stable and lacks certain features, such as severe epidemic tendencies and ready amenability to control, commonly found in other malarious regions. The particular conditions giving rise to stability are described in detail, and the ways in which they can be modified to bring about control of the disease in its stable form are outlined. The importance of measuring certain rates—for example, the basic reproduction rate [*cf. R.A.E.*, B **42** 82; **46** 202], the index of stability, and the actual reproduction rate—when making any major malaria survey is emphasised, and formulae by means of which such rates can be readily calculated are included in an annex.

de Zulueta (J.). **Malaria in Sarawak and Brunei.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 651–671, 5 figs., 1 fldg. map, 4 refs. Geneva, 1956. (With a Summary in French.)

The results are given of a malaria survey made in Sarawak and Brunei in 1952–53; contrary to expectation in view of the climate and the general conditions, the average prevalence of the disease was low. The coastal areas were practically free from it, although epidemics have occurred there in recent years [*cf. R.A.E.*, B **42** 146], but it was endemic in the hilly and mountainous interior. In general, the more abrupt the country, the higher the spleen and parasite rates. Differences in the prevalence of the disease among the various racial groups were attributed to different habits and customs.

Anopheles balabacensis Baisas is the vector of malaria in Brunei as well as North Borneo, but investigations in the interior of Sarawak showed that *Anopheles leucosphyrus leucosphyrus* Dön. was the main vector there [*cf.* **44** 86], *A. barbirostris* Wulp playing a secondary part. A sporozoite rate of 0·4 per cent. was found in 7,568 females of *A. l. leucosphyrus* dissected in the upper Baram district. The females were found to be much more abundant in houses after midnight than before it [*cf.* **44** 86; **46** 112], whereas those of *A. barbirostris* and *A. letifer* Sandosham tended to be earlier. Considerable numbers of all three species rested more than 5 ft.

above floor level. Populations seemed to fluctuate with slight changes in rainfall in Baram district, but an apparent tendency for transmission to be higher from January to June than from July to December could not be correlated with rainfall or vector populations. In southern Sarawak, case incidence increased in the comparatively dry part of the year, reaching a peak in October. The favourable results of a first field trial of insecticides are mentioned [*cf.* next abstract], and plans for a nation-wide malaria-control programme are outlined.

DE ZULUETA (J.) & LACHANCE (F.). **A Malaria-control Experiment in the Interior of Borneo.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 673–693. 3 figs., 4 refs. Geneva, 1956. (With a Summary in French.)

The following is almost entirely based on the authors' synopsis. A first experiment on malaria control in the interior of Borneo by treatment of dwellings with insecticide against the Anopheline vectors is described. The work was carried out between November 1952 and January 1955 in the isolated, sparsely populated valley of the Baram River in northern Sarawak and the valley of its tributary, the Tinjar, was used as a control. *Anopheles leucosphyrus* Dön. was the main vector in both valleys, and *A. barbirostris* Wulp a secondary vector [*cf.* preceding abstract]. Wettable-powder suspensions of the insecticides were sprayed on the interior walls of the dwellings and the poles and undersides of the platforms on which village houses stand at rates of 2 g. DDT or 0·1 g. γ BHC per sq. metre; the DDT was applied twice a year over an area of about 1,800 sq. miles and the BHC four times a year over 160 sq. miles.

The results of spraying were satisfactory. The parasite and (in brackets) spleen rates in children fell from 35·6 (51·8) to 1·6 (25·1) in the DDT area and from 31·4 (41·1) to 2·9 (14·4) in the BHC area, whereas both rates increased in the Tinjar valley. It is considered that if such a high degree of control can be obtained in 21 months, complete eradication can be expected in a short time. Although BHC proved effective, the need to apply it every three months makes it impracticable in the interior of Sarawak, where communications are poor and transport difficulties great. DDT, which need only be applied twice a year, is therefore to be preferred. The cost of treatment with it is comparatively high because of the difficulty of communications and the necessity for spraying the temporary shelters that the people build each year in the rice-fields as well as the dwellings in the villages.

ARCHIBALD (H. M.). **Malaria in south-western and north-western Nigerian Communities.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 695–709, 3 figs., 11 refs. Geneva, 1956. (With a Summary in French.)

A comparison is made between the epidemiologies of malaria in representative communities of south-western and north-western Nigeria (Ilaro and Birnin Kebbi, respectively). The climates of the two areas are contrasted and their influence on the seasonal densities and sporozoite rates of the local vectors, *Anopheles gambiae* Giles and *A. funestus* Giles, is shown. The north-western area is savannah with rainfall practically confined to June–September. The south-west is secondary forest with patchy clearing and has rain throughout the year. Very little seasonal variation was found in the sporozoite rates in Ilaro, which in 1949–50 varied from 4 to 5·9 per cent. in *A. gambiae* and from 3·3 to 5·2 per cent. in *A. funestus*. In the north-west on the other hand, it was very hard to find sporozoites in the dry season but the rates in the wet season were 3·7 and 2·3 per cent. in *A. gambiae* and *A. funestus*, respectively. Similarly, the densities of the mosquitos, particularly *A. gambiae*, fluctuated with season in the north-west but not in the south-west. Malaria occurs in holoendemic proportions in both areas, but the dry season in the north makes possible a general fall in both spleen and parasite rates, which is especially marked in the very young. *Plasmodium falciparum* is the commonest parasite throughout Nigeria, but *P. malariae* also occurs. The effect of malaria on local morbidity and mortality is discussed, with special reference to children under school age. It is established that one child in three dies before adolescence in the south-west. In the north-west, the figure is believed to be one in two. Infants appear to be born with some passive immunity in the former area, but are susceptible from birth in the latter.

Joncour (G.). **La lutte contre le paludisme à Madagascar.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 711–723, 3 figs. Geneva, 1956. (With a Summary in English.)

The following is based on the author's summary. Malaria control in Madagascar was re-organised in 1949. It is based on spraying of the interiors of dwellings and outhouses virtually throughout the island, chemoprophylaxis of the entire child population, and control of Anopheline larvae, principally in large centres of population. Spraying is carried out yearly (twice a year in one province) with a wettable-powder suspension of DDT or an emulsion of a concentrate containing 10 per cent. technical DDT, 7 per cent. octachlorodiphenyl and 3 per cent. γ BHC. The action of the emulsion lasts 7–9 months. This is adequate on the High Plateaux, where the transmission season lasts hardly more than five months, but insufficient in the coastal and forest areas, where transmission takes place throughout the year. In 1954, 1,280,000 houses were treated. All children are given chloroquine weekly from the day of birth until they leave school. The reduction in infant mortality that followed a sudden decrease in cases of pernicious malaria is attributed to this chemoprophylaxis.

Malaria was mesoendemic in 30 and hypoendemic in 50 of the 80 districts of the island in 1955, whereas it had been holoendemic in 11, hyperendemic in 42 and mesoendemic in 27 before 1949. After comparing conditions in the various regions as regards endemic malaria before 1949 and in 1955, the author concludes that the rapid fall in the general parasite rate was due to the regularity of chemoprophylactic treatment. There were few control areas remaining, but investigation of a region very difficult of access, where neither spraying nor distribution of chloroquine had ever taken place, showed the spleen and parasite rates in children 2–10 years old to be 72 and 30 per cent. in 1955.

Ciuca (M.). **Le paludisme en Roumanie de 1949 à 1955.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 725–751, 5 figs., 9 refs. Geneva, 1956. (With a Summary in English.)

About 300,000 cases of malaria used to occur in Rumania annually before the second world war. A third of the country is suitable for the development of the vector mosquitos, which are *Anopheles maculipennis* Mg. vars. *maculipennis* (*typicus*), *messeae* Flni. and *atroparvus* van Thiel, and *sacharovi* Favr, which the author treats as a distinct species. *A. m. atroparvus* and *A. m. sacharovi* predominate on the Black Sea coast where the waters are brackish, *A. m. messeae* in marshy areas, such as the Danube flood-plain and the delta, and *A. m. maculipennis*, which seems to play a negligible part in transmission, in the hilly regions. They all hibernate as adults, and *A. m. atroparvus* is the only one that does not hibernate completely. The over-wintered females become active in March and oviposit in late March or early April, and adults of the spring generation emerge from 8th to 25th May in most areas and a fortnight later on the coast and in the north of Moldavia. There are 5–7 generations a year.

The level of endemic malaria increased between 1941 and 1947, and hyper-endemic outbreaks occurred in certain areas to which *A. m. sacharovi* had spread from the coast. In 1949, an extensive malaria-control network was set up to cover all the malarious parts of the country, with fixed stations, mobile teams and haematological and entomological laboratories. During the first stage of control (1949–50), priority was given to spraying of houses, animal shelters, and eaves with DDT or BHC in oil solution or DDT in emulsified solution at rates to give 2 g. DDT or 0·3–0·37 g. γ BHC per sq. metre. Spraying was generally carried out only once a year, two weeks before the spring generation emerged, but was repeated if inspections showed the presence of 40 mosquitos per dwelling in about 30 per cent. of the houses examined. Breeding was reduced in some areas by the building of dikes to prevent flooding and by draining and the use of *Gambusia*. Chemotherapy and chemoprophylaxis of certain particularly exposed populations were also undertaken. During the second stage (1951–52), the results so far achieved were consolidated, and chemotherapy and chemoprophylaxis were intensified. During the third stage (1953–54), spraying was discontinued in some localities that had been treated for 3–4 years, but protective zones of spraying were set up round them. In regions that were still very malarious, anti-mosquito measures were continued, either on a large scale or in selected foci. The number of notified new cases of malaria and (in brackets) relapses fell progressively in each year of the campaign; they were 210,111 (128,087) in 1948, 55,175 (40,294) in 1950, 565 (351) in 1954 and 265 (102) in the first ten months of 1955. From 1955 onwards, malaria eradication was aimed at.

An account is given of field and laboratory observations made with a view to detecting any appearance of resistance to DDT or BHC among Anophelines, but no evidence of it was found.

Simič (Č.). **Le paludisme en Yougoslavie.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 753–766, 3 figs. Geneva, 1956. (With a Summary in English.)

Systematic study of malaria in Yugoslavia began in 1922, and showed that conditions were favourable to endemic malaria in at least one-third of the country. It was estimated that between 1930 and 1935, 1–1·2 million people out of a population of about 16 million, mostly in Macedonia, Dalmatia and Montenegro [*cf. R.A.E.*, B **24** 161], suffered from malaria each year. The position in Macedonia from 1934 to 1937 [**24** 161; **25** 33, etc.] and that in Yugoslavia as a whole from 1941 to 1947 are reviewed. Until 1947, endemicity was kept in check by chemotherapy and limited measures against the larvae of the vectors, which in Macedonia are chiefly *Anopheles maculipennis* Mg. and *A. superpictus* Grassi. Spraying of dwellings with DDT in emulsified solution at 1 g. per sq. metre began in 1947 and has since continued without interruption. It was at first supplemented in Montenegro, Serbia and Macedonia, by the use of DDT as a larvicide. The work was carried out by a centralised, federal service from 1947 to 1950 with the object of interrupting transmission of malaria, and the numbers of recorded cases in the four years were 81,400, 40,295, 8,567 and 1,040, respectively. Spleen rates in Macedonia and Dalmatia fell from 28·29 and 21·73, respectively, in 1948 to 3·47 and 1 in 1950, and the proportion of cases caused by *Plasmodium falciparum* fell to a very low level by 1949, when *P. vivax* was responsible for 97 per cent. of the cases recorded at Skoplje. There was no evidence that measures against the larvae increased the control effected by house-spraying.

In 1950, malaria was considered to be under control, and the service was decentralised. Measures in the hypoendemic areas were discontinued, except that a careful watch was kept for the appearance of new cases and the foci thus discovered were dealt with. In Macedonia and Kosova-Metohija, technical difficulties impeded spraying in 1953 and 1954, and the number of cases rose then and in 1955. Laboratory studies carried out with some 14,500 adults of *A. maculipennis* showed that the recrudescence of the disease in these provinces was not due to the development of resistance by the mosquitos. DDT was still effective against them. Control services were strengthened, and it was planned to continue chemotherapy and selective annual house-spraying in 1956 in the provinces where control was proceeding satisfactorily and to intensify spraying with applications twice a year, in May and August, in Macedonia and Kosova-Metohija.

Good control of *Musca domestica* L. was obtained in 1947, but signs of resistance developed in 1948, and resistant strains were reported in all treated areas in 1949.

Chow (C. Y.) & Soeparmo (H. T.). **DDT-resistance of** *Anopheles sundaicus* **in Java.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 785–786, 2 refs. Geneva, 1956.

In June–October 1955, the susceptibility of *Anopheles sundaicus* (Rdnw.) to DDT in Semarang, central Java, where indoor spraying with a water-dispersible powder at 2 g. DDT per sq. metre had been carried out since January 1953, and in Jepara, an unsprayed area some 50 miles to the east, was compared by the standard Busvine method [*cf. R.A.E.*, B **46** 203]. Control at Semarang was satisfactory for two years, during which time three applications were made, but after this, *A. sundaicus* reappeared and cases of malaria in infants were reported. The median lethal concentration (LC50) of DDT for females from Jepara was found to be 0·2–0·5 per cent. That for females from Semarang was not determined accurately but was at least ten times as high and probably more. The LC50 of dieldrin was about 0·075 per cent. in Semarang and slightly less in Jepara. Many females of *A. sundaicus* were found resting in the daytime on surfaces that had been sprayed with DDT five or eight months or even only one day previously. Over 80 per cent. of them were engorged and about 93 per cent. survived for more than 48 hours in the laboratory after collection. DDT was used as a larvicide in the Semarang area in 1945–47, and two localities in western Java in which DDT resistance in *A. sundaicus* has been reported [**44** 163] also have a history of use of DDT as a larvicide. This seems to confirm the view that the widespread application of insecticides against larvae is an important contributory factor to the appearance of resistance.

Busvine (J. R.). **A Survey of Measurements of the Susceptibility of different Mosquitos to Insecticides.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 787–791, 8 refs. Geneva, 1956.

The LC50's of DDT, dieldrin and γ BHC, determined by the standard Busvine method [*cf. R.A.E.*, B **46** 203], for mosquitos (mainly *Anopheles* spp.) of normally susceptible strains from various parts of the world and a smaller number of resistant strains, and also the LC90's for a few of the susceptible strains, are given in tables, with the appropriate bibliographical references. To interpret differences in resistance between species or changes in the same species due to acquired resistance, something should be known of the sensitivity of the test, and the slope of the dosage–mortality regression line is a good indicator. The ratios of the LC90's to LC50's in the tests recorded range from 1·5 to 3·6, whereas they are 10–50 in tests with other formulations, such as powders or dry crystalline deposits. It is pointed out that the statistical validity of the LC50 estimated by the probit method depends on a normal distribution of susceptibility within a population, and that whereas there is likely to be such a distribution in a laboratory colony reared under standard conditions and, within reasonable limits, in normally susceptible mosquitos caught in the field, resistant strains are believed to be commonly heterogeneous, sometimes grossly so.

Ayurakitkosol (L.) & Griffith (M. E.). **The developing Antimalaria Vigilance Programme in Thailand.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 799–805. Geneva, 1956.

Malaria was the chief cause of sickness and death in Siam in 1949, when a successful campaign for the control of *Anopheles minimus* Theo., the vector throughout most of the country, was begun. The method used was the spraying of houses with DDT at the rate of 2 g. per sq. metre once a year for as many years as surveys showed it to be necessary. The sprays were applied in February–May (dry season) to precede the increase in numbers of the vector that occurs in the wet season and the surveys were made in July–December. Three years' spraying has eliminated *A. minimus* and the disease in many groups of villages, and five years' spraying has done so in 90 per cent. of the sprayed areas, but the surveys are continued in the cleared villages and the spraying is renewed if the Anopheline or the disease reappears. Prospects in the future are discussed.

Ch'en (C. T.) & Liang (K. C.). **Malaria Surveillance Programme in Taiwan.** —*Bull. World Hlth Org.* **15** no. 3–5 pp. 805–810, 2 refs. Geneva, 1956.
Hsieh (H. C.) & Liang (K. C.). **Residual Foci of Malarial Infection in the DDT-sprayed Area of Taiwan.**—*T. c.* pp. 810–813.

The malaria situation in Formosa in 1955 is reviewed in the first paper. The principal vector is *Anopheles minimus minimus* Theo., which is a highly domestic mosquito, and house spraying with DDT, carried out for three years over the whole island, virtually arrested transmission of the disease over most of the areas in which it was previously important. It was proposed to continue the island-wide spraying in 1956 and 1957, but the main problem remaining was the existence of isolated foci, few in number but scattered throughout the island, in which transmission persisted. A programme of surveillance, designed for the elimination of residual malaria, is outlined.

One of the foci in which malaria transmission persists is described in the second paper; its features are in many respects similar to those of the other three foci so far detected. It is a valley in the centre of the island with a population of only 49 families living in houses scattered over an area of 2·3 sq. miles. The houses are poorly constructed, with thatched roofs and walls through which mosquitos can pass, and have no chimneys so that they are heavily sooted from cooking-fires inside them. The valley itself was not surveyed for Anophelines, but *A. hyrcanus sinensis* Wied. as well as *A. minimus* was numerous in neighbouring ones and *A. maculatus* Theo. and other species were also present. The houses in the valley had been sprayed with DDT, but it is doubtful if it would be effective in them. It is also possible that *A. minimus* is more exophilous in such an environment than it usually is and that *A. h. sinensis* or *A. maculatus* were also concerned in transmission, particularly as livestock were virtually absent.

GRAMICCIA (G.). *Anopheles claviger* **in the Middle East.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 816–821, 14 refs. Geneva, 1956.

Anopheles claviger (Mg.) is widely distributed in the Middle East, but the part it plays as a vector of malaria in rural communities is not clear. It has been associated with hyperendemic malaria in Jerusalem, with hypoendemic malaria in the Lebanon and Cyprus and with anophelism without malaria in the Lebanon, Greece and Italy. An attempt is made to estimate its probable importance in the Middle East by examining the reason for its ability to produce hyperendemic malaria in Jerusalem, and determining whether it is a vector in rural communities, and if so whether it can maintain endemicity alone for a long time. In towns, it breeds in underground cisterns and the adults rest in houses. When it breeds in reservoirs in rural communities, the adults usually rest out of doors except in late autumn. When it breeds in natural waters, it seems to be a wild species of no importance. It attacks man readily, mostly in the open and in daylight, though with varying frequency according to season and temperature. In the wild state, it overwinters in the larval stage, but breeding in wells generally continues throughout the year. Observations throughout 1953 in Deddé (Lebanon) showed that it bred continuously in underground cisterns and was also the only species breeding in the nearest open water, a small ditch about two miles away. The adults rested in the cisterns from February to mid-September and in houses in autumn, but left bedrooms and sheltered in animal sheds as the weather became cooler. In many Lebanese localities, where the winter rains flush the breeding places, populations may depend on endophilous adults for survival. Even in the coldest months, females left the cisterns in the afternoon and returned at dusk. They attacked out of doors, in daylight in the cool season and from dusk onwards in summer, when the overall biting rate was lower. When they rested indoors, they bit indoors. In summer, they apparently rest out of doors after feeding. No larvae of other Anophelines were found in Deddé, and no adults of other species from December 1952 to October 1953. After this, two adults of *A. sergentii* (Theo.) and fair numbers of *A. superpictus* Grassi were seen. Parasite indices in children were 1·8, 4·4 and 5·8 per cent. in October 1952, April 1953 and July 1953, and 0 in October and December 1953 after treatment of cisterns with 5 per cent. DDT in fuel oil at 1 ml. per sq. metre water surface every four weeks from July onwards. Labourers in Deddé migrate annually to areas where other vectors are active and may build up their parasite rates.

A. claviger is rarely the only vector in a region. Natural sporozoite infections have been recorded in it in Cyprus, Iraq and Italy. There is full epidemiological evidence that it was a vector in Palestine and sufficient evidence that it was a vector in Lebanon. In 1912, spleen rates in children in Jerusalem were 40–83 per cent. and the total parasite rate was 21·5 per cent. *A. claviger* was the only Anopheline present. It probably produced hyperendemic malaria because it had little opportunity to feed on any host other than man. Treatment of wells, piping of water and obliteration of unused wells brought about complete malaria control. On the other hand, it was not a vector in areas in which it bred in natural water and alternate hosts were available. In villages where there are wells, the situation is intermediate. Positive spleen and parasite indices have been found in a few localities on the limestone hills of Lebanon, with *A. claviger* as the only abundant Anopheline, but the rates were so low and uneven in the hill villages that it was doubted whether it could maintain transmission indefinitely in a sedentary human population.

Full clarification of the importance of *A. claviger* in villages is complicated by the difficulty of catching large numbers of females in outdoor shelters, the difficulty of finding infected females because of low endemicity rates where the species predominates, the existence of more prominent vectors and the frequent movements of the human populations. One of the basic requirements for stopping control in a malaria eradication scheme is complete interruption of transmission for at least three years. As insecticide deposits in houses do not control *A. claviger* and it is probable that it maintains casual transmission for some time after their application begins, simultaneous control of larvae in wells would be advisable for at least the first two years. This would cost less than prolonging the anti-adult spraying programme and be less likely to cause resistance in other species.

Farid (M. A.). **The Implications of *Anopheles sergenti* for Malaria Eradication Programmes East of the Mediterranean.**—*Bull. World Hlth Org.* **15** no. 3–5 pp. 821–828, 9 refs. Geneva, 1956.

Failure to control malaria in the Jordan Valley in 1949–52 was found to be due to its continued transmission by *Anopheles sergentii* (Theo.), which evaded contact with DDT-sprayed surfaces by resting in caves and fissures. Transmission in the valley was eventually stopped by weekly treatment of all potential breeding places with solar oil containing 3 per cent. DDT and 2 per cent. pine resin as a spreader. *A. sergentii* has also continued to transmit malaria in Israel after other vectors have been controlled by DDT in houses [*cf. R.A.E.*, B **43** 171–172], and this may make it a problem throughout the countries east of the Mediterranean, as malaria eradication programmes there are based almost entirely on spraying of houses in rural communities with chlorinated hydrocarbons. *A. sergentii* is distributed across the Sahara belt from the Canary Islands to the Arabian peninsula and Persia, and is considered an efficient malaria vector wherever it exists in its normal range of distribution. In Jordan and Saudi Arabia, it breeds all the year round. In Egypt, it is frequently found up to four miles from breeding places, and wind has been shown to be an important factor in its dispersal. The females bite man and animals indiscriminately both indoors and out. They rest in dark corners of rooms and stables as well as in fissures and niches, but are easily disturbed and avoid resting on sprayed surfaces.

In the light of experience during attempted malaria eradication in countries in which *A. sergentii* occurs, suggestions are made for procedure under various circumstances. Where malaria transmitted by *A. sergentii* can be stopped by anti-adult spraying alone, as it was in the Siwa oasis in the north-western desert of Egypt by six rounds of spraying with DDT over three years, this method should be used exclusively, but the spraying should include all potential resting places within four miles of the breeding places. Larvicides will be necessary where *A. sergentii* cannot be controlled in the adult stage, but paris green or oils, and not chlorinated hydrocarbons, should be used if it is breeding in association with other malaria vectors. Chlorinated hydrocarbons could be used in places in which *A. sergentii* breeds alone and is not itself resistant to them; they should be applied repeatedly in accessible areas and once or twice on breeding places that are difficult to reach. It has been found that a dieldrin wettable-powder suspension applied to the edges of streams, including banks and vegetation, at 0·25 g. technical dieldrin per sq. metre, eliminates breeding of *A. sergentii* for 3–7 months. Wherever eradication of malaria transmitted by *A. sergentii* necessitates the use of larvicides, rice cultivation should be prohibited until it has been achieved, as repeated use of paris green or oils would otherwise be too expensive and chlorinated-hydrocarbon larvicides would induce resistance in other species.

RONNEFELDT (F.). **Beobachtungen über das Verhalten von** *Anopheles punctimacula* **nach der Anwendung von DDT.** [Observations on the Behaviour of *A. punctimacula* after the Application of DDT.]—*Z. Tropenmed. u. Parasit.* **8** pt. 3 pp. 376–391, 13 refs. Stuttgart, 1957. (With a Summary in English.)

Anopheles punctimacula D. & K. is believed to be the chief or only vector of malaria in the mountainous parts of Colombia in which *A. pseudopunctipennis* Theo. is rare [*cf. R.A.E.*, B **37** 11], including the part of the Cauca Valley north-east and south of Cali at an altitude of about 3,300 ft. It is an exophilous species, and the effect on it, and on transmission of malaria, of treatment of houses with DDT was investigated in 1953–56, chiefly at Gorgona, a village of 380 houses some 19 miles east of Cali. Almost all of the houses in Gorgona were sprayed five times with DDT; the sprays were applied in July 1953, April and November 1954, June 1955 and February 1956 to give a deposit of 2 g. DDT per sq. metre on the inside walls and also on parts of the outside walls well protected from rain. About half the houses were dispersed in coffee plantations in which the shade trees provided day-time resting places for *A. punctimacula*, and systematic collections of the adults were made in and near the houses and in the plantations at intervals from December 1953 to August 1954 and April 1955 to March 1956.

The numbers of *A. punctimacula* in the plantations were greatest in May–August and December–February, increasing after the high rainfall of April–May and October–November; it is suggested that the increase was due both to the availability of new breeding places (mainly clay pits in the plantations) and to their initial freedom from predators that destroy the larvae in older ones. There was no evidence that the DDT reduced the numbers of mosquitos in the plantations, but some that it prevented the females from resting in the houses after they had fed, as the percentages of females in the resting population in the plantations and (in brackets) the percentages of them that contained blood increased from 36 (22) before the second spraying to 51 (48) after the fifth.

The numbers of females caught per man-hour in the vicinity of the houses and (in brackets) the percentages that contained blood fell from 2·4 (29) in 1954 to 0·5 (4) in 1955–56. Mosquitos were still found inside 10 per cent. of the sprayed houses after the second spraying, but the proportion that had fed was much smaller than in the unsprayed ones. Both sprayed and unsprayed houses were free from mosquitos after the fourth spraying and remained so for seven months, a few reappearing just before the fifth application. The malaria parasite rate in man fell from 11 per cent. before the first spraying to less than 1 per cent. after the second and third, and only sporadic cases of infection were subsequently encountered.

An area of about 28 sq. miles some 31 miles south of Gorgona was surveyed after most of the houses in it had been sprayed twice with DDT. Cacao was the principal crop and the soil was more swampy than in Gorgona so that *A. punctimacula* and cases of malaria were more numerous. The exact location of the houses, which were uniformly distributed, was made by the use of a recent aerial survey map, and the main object of the survey was to estimate the amount of protection afforded to the Anopheline by the presence of the unsprayed houses, but no conclusion on this could be drawn, because of its exophilous habits and the finding that the percentages of sprayed and unsprayed houses with cases of malaria were not significantly different. The average distance between one infection and the next with the same malaria parasite was about 1,000 yards, and that between an infection and the nearest unsprayed house was just under 700 yards.

Hecht (O.) & Corzo (J. H.). **Beitrag zur Biologie einiger mexikanischer Anophelen.** [Contribution to the Biology of some Mexican *Anopheles*.] —*Z. Tropenmed. u. Parasit.* **8** pt. 3 pp. 391–404, 17 refs. Stuttgart, 1957. (With Summaries in English & Spanish.)

The principal vectors of malaria in Mexico are *Anopheles pseudopunctipennis pseudopunctipennis* Theo. and *A. albimanus* Wied., but there is conflict of opinion as to whether *A. albimanus* is a house mosquito [*cf. R.A.E.*, B **41** 91; **42** 85] and consequently whether malaria transmitted by it would be controlled by treatment of houses with DDT [*cf.* **40** 101; **42** 105; **43** 78; **44** 27]. Observations on its resting habits were accordingly made at places ranging from the State of Veracruz to Yucatan and on the Pacific coast in the State of Guerrero. It was found that females enter huts and houses early in the night and feed there, but leave within a few hours unless they find suitable resting places. They hardly ever rested low down on the mud walls of dwellings, though they did so on similar walls of open sheds and shelters, but were commonly found at heights of 10–16 ft. or more in tall houses, where they remained under or near the thatch of the roof during the process of blood digestion and ovarian development. It is possible that their selection of resting places, both in open sheds and tall houses, is due to a preference for a situation where there is a passage of air.

The authors conclude that DDT sprays could eradicate malaria transmitted by *A. albimanus* provided that they were applied to the sheds and similar shelters and that house spraying included the higher parts of the walls and the roofs. This would involve spraying to heights of 16–25 ft., but control without it, if obtainable, would be delayed and would necessitate more numerous applications, with consequent increase in the risk of producing DDT-resistant strains of the mosquito [*cf.* **42** 105].

Incidental observations on *A. p. pseudopunctipennis* on the Pacific coast showed that its behaviour there was entirely different from that recorded for it in the State of Morelos (at 4,600 ft.) [**41** 88] and resembled that of *A. albimanus* in that the females were not found by day in low dwellings but rested under the thatched roofs of tall ones. In the State of Veracruz, females of *A. vestitipennis* D. & K. flew into houses at night and fed on man there. Some rested for a time on the walls in the rooms, but more, both fed and unfed, were found on outside walls, chiefly within 3 ft. of the ground. They remained there for several hours, but flew away at or before daybreak.

Haufe (W. O.) & Nelson (W. A.). **Human furuncular Myiasis caused by the Flesh Fly *Wohlfahrtia opaca* (Coq.) (Sarcophagidae: Diptera).**—*Canad. Ent.* **89** no. 7 pp. 325–327, 16 refs. Ottawa, 1957.

Records of cases of human dermal myiasis caused by *Wohlfahrtia* in western Canada and the western United States are reviewed [*cf. R.A.E.*, B **26** 4, 78; **34** 101; **38** 62], and accounts are given of five cases in infants reported to the laboratory at Lethbridge, Alberta, in 1953 and 1955 and one in a kitten in the same area in 1953. Adults reared from larvae from two of the babies and the kitten all proved to be *W. opaca* (Coq.). All reports to date indicate that this fly is probably restricted to the central Great Plains and inland Rocky Mountain areas of the northern United States and southern Canada. Its distribution and differences in adult marking indicate that it is racially if not specifically distinct from *W. vigil* (Wlk.), which has been reported causing myiasis in eastern Canada [**25** 10], and James & Gassner [**39** 35] consider *W. meigenii* (Schin.) a Palaearctic species. Parasitism in man by the North American species is restricted to infants under one year old. It is thought to occur when the mammals that provide the normal hosts [*cf.* **38** 62; **39** 87] are not available in sufficient numbers.

Perraju (A.) & Tirumalarao (V.). *Stomoxys calcitrans* **L. (Stable Fly) Occurrence as a Pest of Cattle.**—*Indian J. Ent.* **18** (1956) pt. 4 pp. 349–356, 5 figs., 11 refs. New Delhi, 1957.

Stomoxys calcitrans (L.) has developed into a serious pest of cattle in the melon-growing areas of Cuddapah District (southern India), because of the success with which it breeds in the oilcakes (chiefly groundnut oilcake) applied as manure to the melon crop. The melons are planted in the bed of the Pennar river from November to March as the water recedes, and the oilcake is applied at the base of the plants at four stages of growth. The season during which conditions are suitable for breeding is therefore very long, and huge populations of flies are built up from January to May. Various mechanical, cultural and chemical methods of control were tried up to 1944 but were unsuccessful, as was an attempt between 1944 and 1953 to enforce an order prohibiting the use of cake manure. In 1954, BHC, DDT, HETP [hexaethyl tetraphosphate], parathion, mercurous chloride and borax were applied to the melon plants mixed with the oilcake, but they were ineffective and all except the phosphorus compounds were toxic to the plants. A dust containing 0·65 per cent. γ BHC (lindane) applied to the base of the plant and mixed with the soil used to cover the manure was effective, if 2 oz. dust was used per plant, but this was too expensive to be practicable. Further experiments showed that a 2:2:1 mixture of oilcake, ammonium sulphate and superphosphate gave a combination that did not attract *S. calcitrans*, as it lacked the characteristic putrid odour of the fermenting cake alone, and it provided a good balanced fertiliser at no extra cost. It was used by many of the melon growers in 1955, and a considerable reduction in the numbers of flies resulted.

Micks (D. W.) & Gibson (F. J.). **The Characterization of Insects and Ticks by their free Amino Acid Patterns.**—*Ann. ent. Soc. Amer.* **50** no. 5 pp. 500–505, 10 figs., 5 refs. Washington, D.C., 1957.

The following is based on the authors' summary. Quantitative chromatographic methods were used to compare the patterns of free amino acids obtained from 27 strains and species of arthropods, including mosquitos, *Triatoma* spp., cockroaches and ticks of the genus *Dermacentor* [*cf. R.A.E.*, B **46** 115]. One-dimensional chromatograms and density curves obtained therefrom were found to be completely reproducible for each species studied. Marked quantitative differences in amino-acid concentrations were observed between all genera and species of the four orders studied. These differences usually involved several amino acids, although two species belonging to the same genus appeared to differ only in their content of a single amino acid. In most instances, different strains of the same species presented considerably different amino-acid patterns.

SHEPARD (H. H.). Ed. **Methods of testing Chemicals on Insects. Volume I.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., [4+] iv +, 356 pp., 43 figs., $28\frac{1}{2}$ pp. refs. Minneapolis, Minn., Burgess Publ. Co., 1958. Price £2 or $5.

This first volume of a series consisting of review articles by various authors on methods available for laboratory studies of different aspects of the action of chemicals on insects is devoted to investigation of the effects of the compounds on insect physiology and to general techniques for their application. The subjects dealt with are **Surface Phenomena in Relation to Insect Cuticle,** by W. M. HOSKINS (pp. 1–16), who considers the effect on the functioning of the cuticle of contact of insecticides with the outermost layer; **Penetration of Cuticle,** by A. G. RICHARDS (pp. 17–34. 4 figs.); **Measurement of Insect Respiration,** by R. CRAIG (pp. 35–44); **Electrophysical Preparations in the American Cockroach,** by K. D. ROEDER & E. A. WEIANT (pp. 45–60. 2 figs.), in which instructions are given for making preparations of the nervous system of *Periplaneta americana* (L.) for studies of nerve activity by electrical methods; **Study of the Circulatory System in Insects,** by R. L. PATTON (pp. 61–75); **Radioactive Tracer Methods,** by A. W. LINDQUIST (pp. 76–82); **Resistance Studies,** by W. V. KING (pp. 83–91), who deals with the determination of resistance to insecticides in insects and the production of resistant laboratory strains; **Methods of topical Application and Injection,** by R. L. METCALF (pp. 92–113, 3 figs.); **Feeding and Drinking Methods,** by F. W. FISK (pp. 114–129); **Dipping Methods,** by A. H. MCINTOSH (pp. 130–153, 1 fig.); **Precision Spraying,** by C. POTTER & M. J. WAY (pp. 154–258, 14 figs.), in which forms of apparatus designed for the accurate application of sprays to insects or to leave films on surfaces are described and factors influencing the results discussed; **Precision Dusting,** by J. E. DEWEY (pp. 259–274, 4 figs.); **Testing Fumigants,** by R. T. COTTON (pp. 275–313, 13 figs.); and **Synergism and Antagonism,** by N. TURNER (pp. 314–324, 2 graphs), who reviews the types of joint action of ingredients in toxicant mixtures and methods of determining them.

JAHN (E.). **Insektenviren.** [Insect Viruses.]—*Probl. Bioklimat.* **4**, $9\frac{1}{4} \times 6\frac{1}{4}$ ins., xii + 200 pp., 67 figs. (2 col.), 11 pp. refs. Leipzig, Akad. Verlagsges. Geest & Portig K.-G., 1958. Price *DM*. 24.

This survey of the relations between insects (or other arthropods) and viruses is based on literature published up to about the end of 1956 and the author's own investigations. The first chapter comprises an introductory review of the general properties of viruses, the inclusion bodies associated with some of them, their multiplication in their hosts, and methods of isolating them, and the second is devoted to viruses pathogenic to insects. The third is concerned with viruses pathogenic to plants, and viruses and rickettsiae pathogenic to man or domestic animals, that are transmitted to them by insects or other arthropods. Lists of the known vectors are given, showing the diseases transmitted by them; the common properties of the vectors, the mode of transmission and the relations of the vectors to the viruses and rickettsiae are discussed; some of the more important of the agents concerned and their relation to the tissues of the host are described, with their effects, if any, on the vectors; and the course of the virus or rickettsia in the body of the vector, and the pathogenicity of the viruses of man and animals are reviewed. The fourth chapter comprises a discussion of the diverse factors on which the occurrence of virus diseases pathogenic to or transmitted by insects depends, the fifth is a discussion of the various theories as to the nature and origin of viruses, and the sixth is a review of work on the use of viruses for the control of insect pests of plants and of methods of controlling insects that transmit plant viruses.

PAPERS NOTICED BY TITLE ONLY.

GRUNIN (K. Ya.). **Insects: Diptera. Vol. XIX, pt. 3. Nasal Botflies (Oestridae)** [of U.S.S.R.]. [*In Russian.*]—*Fauna SSSR* N.S. no. 68, 10¼ × 6½ ins., 147 pp., 230 figs., 6½ pp. refs. Moscow, Zool. Inst. Akad. Nauk SSSR, 1957. Price 9 *rub.* 90 *kop.*

DOSS (M. A.), HUMPHREY (J. M.) & SEGAL (D. B.). **Index-catalogue of Medical and Veterinary Zoology. Supplement 7. Authors: A to Z.**—pp. [1+] 1789–2139. Washington, D. C., U.S. Dep. Agric., 1957. Price $1.25 (from Supt. Documents). [*Cf. R.A.E.*, B **45** 152.]

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